27 JUNE 1958

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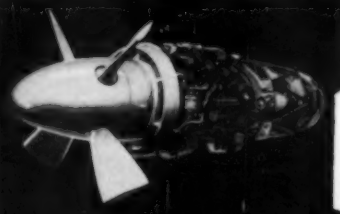
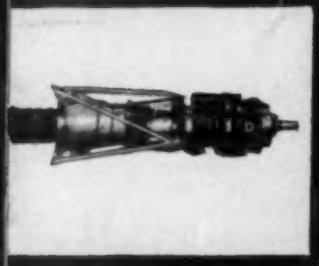
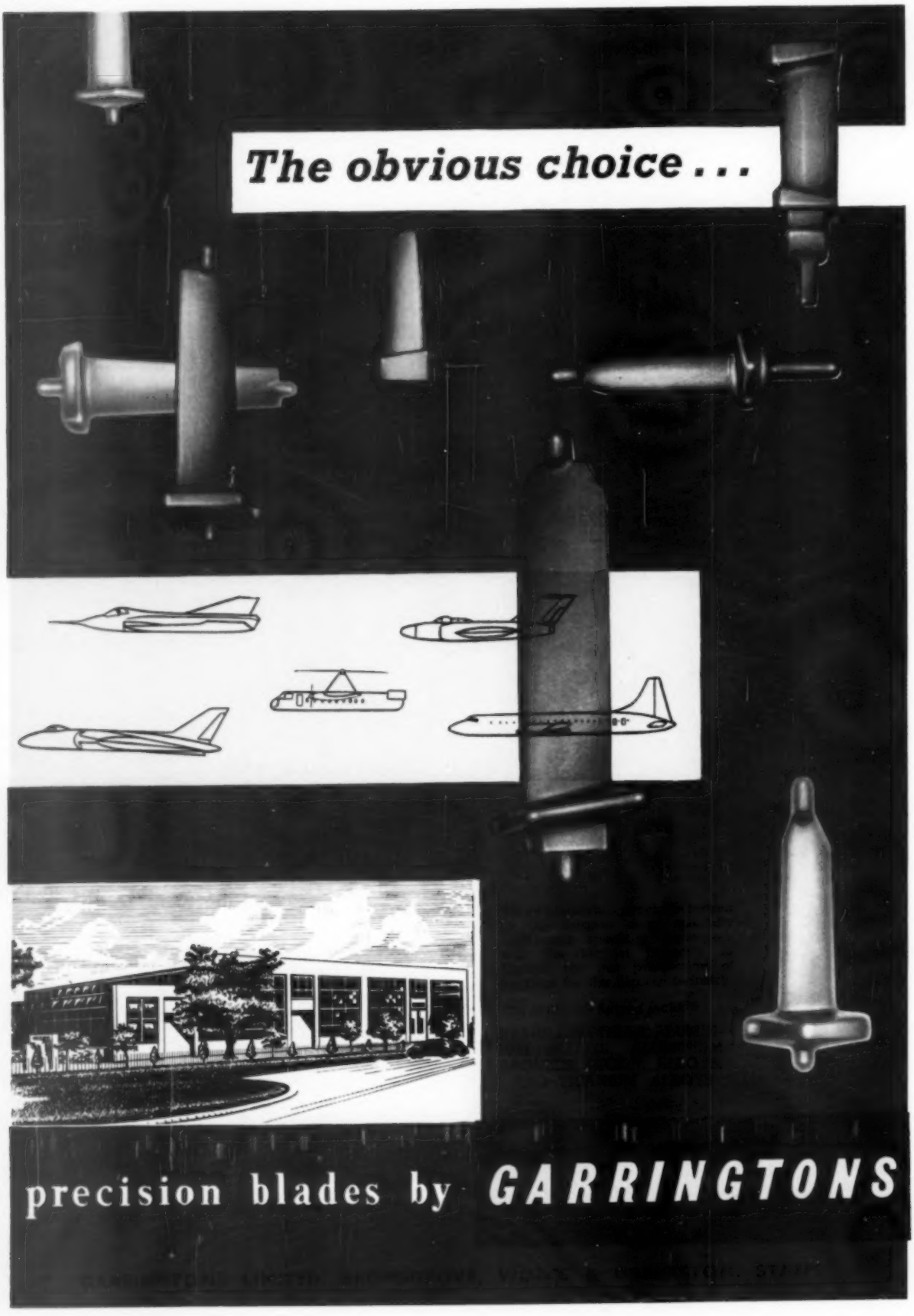


NAPIER

POWER FOR THE WORLD

Bristol 192 H[illegible] for Royal Air[illegible]

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precision blades by GARRINGTONS

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58

Westland Widgeon Helicopters operated by SABENA

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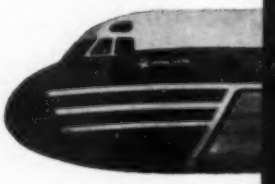
Electra



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All Electra Guarantees met—

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Electra's 4 General Motors Allison Prop-Jet Engines will have accumulated a combined total of 350,000 ground and flight test hours before entering airline service this fall . . . one of the most comprehensive engine-package test programs ever undertaken.

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Flight

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The finest short-to-medium haul turbine-age airliner—designed to assure you maximum return on every operating dollar.

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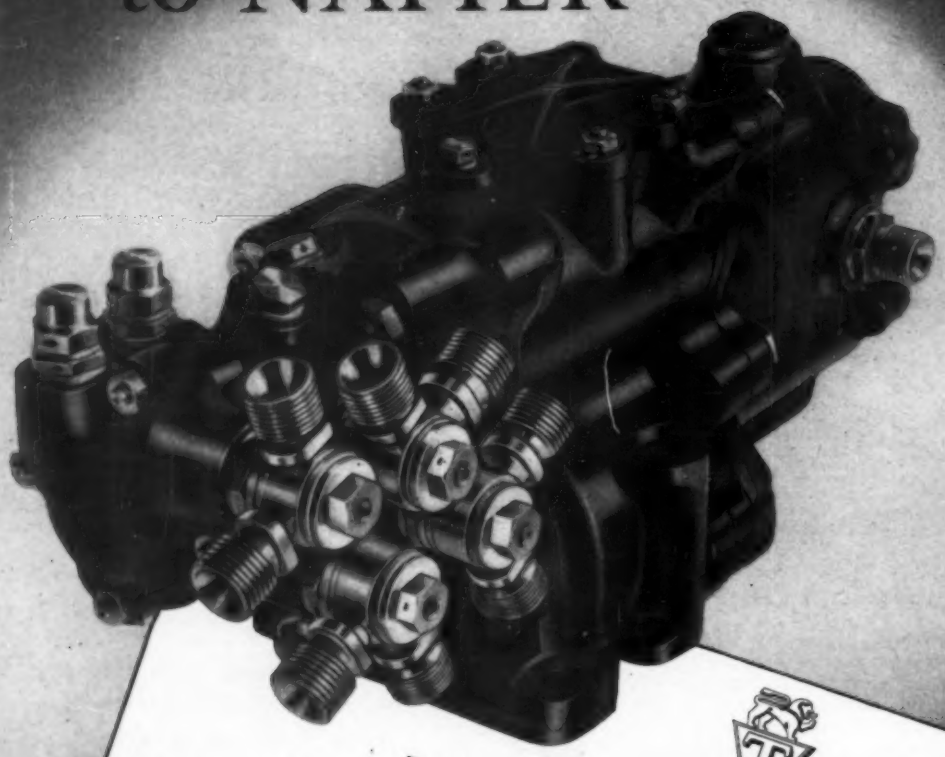

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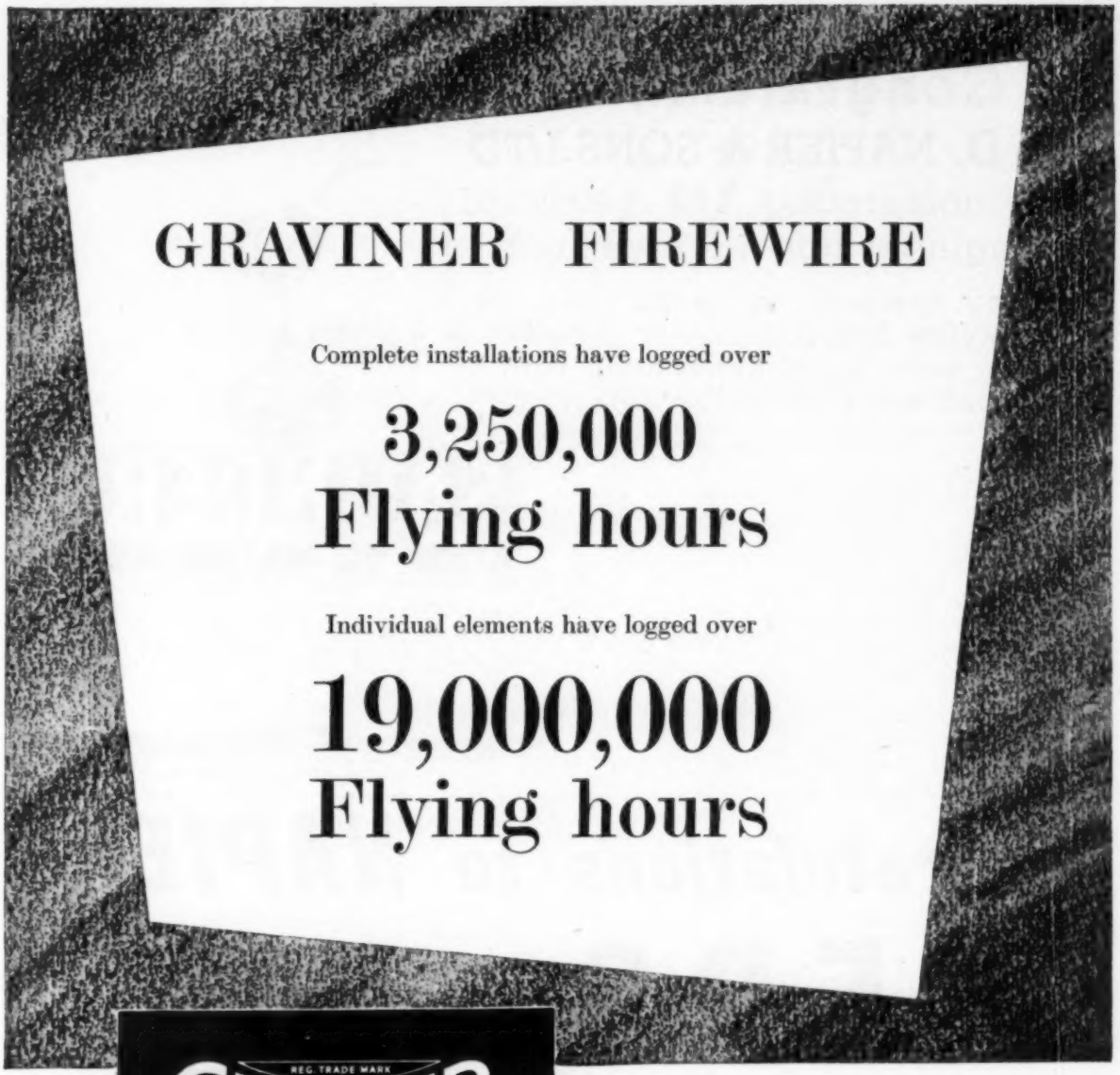

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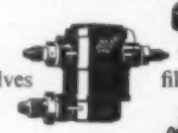

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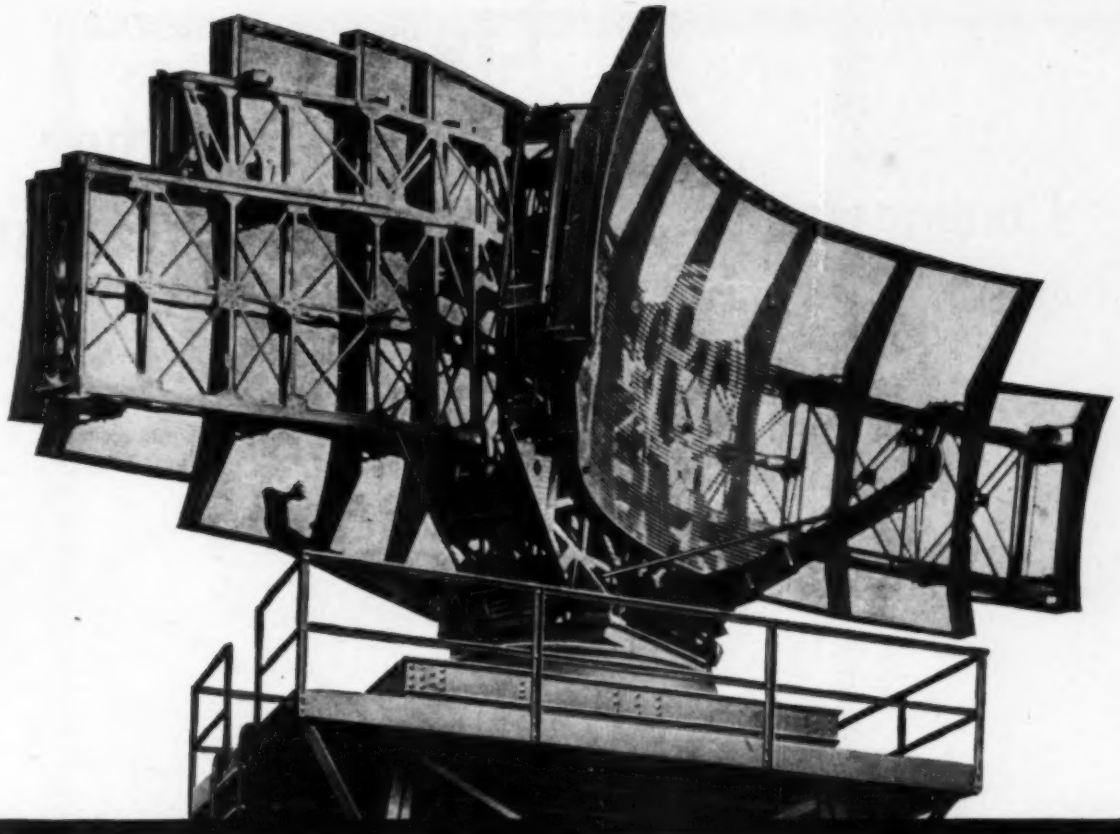

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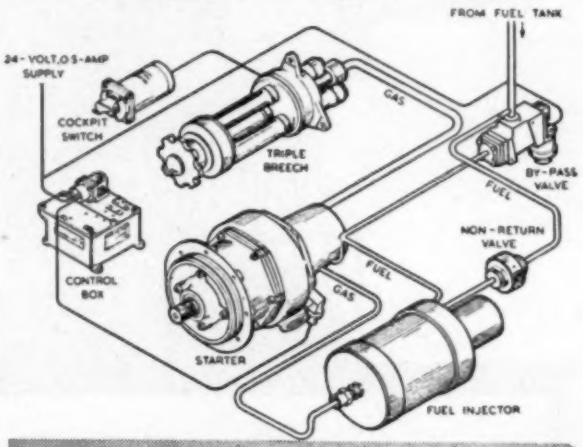

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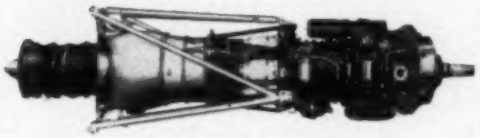
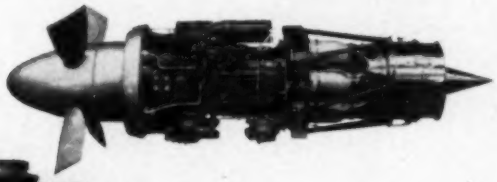
on their 150th Anniversary

and on their countless brilliant engineering achievements

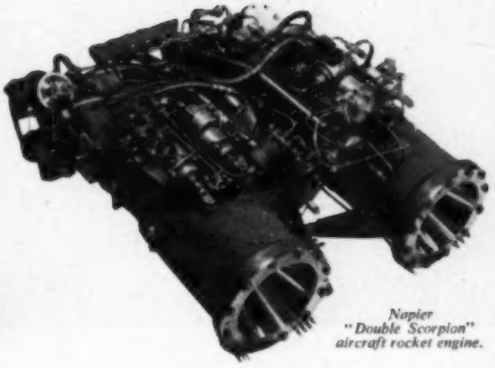


Napier "Eland" N. E1.3.



Napier "Eland" N. E1.6.

Napier "Gazelle" free turbine engine.



Napier "Double Scorpion" aircraft rocket engine.

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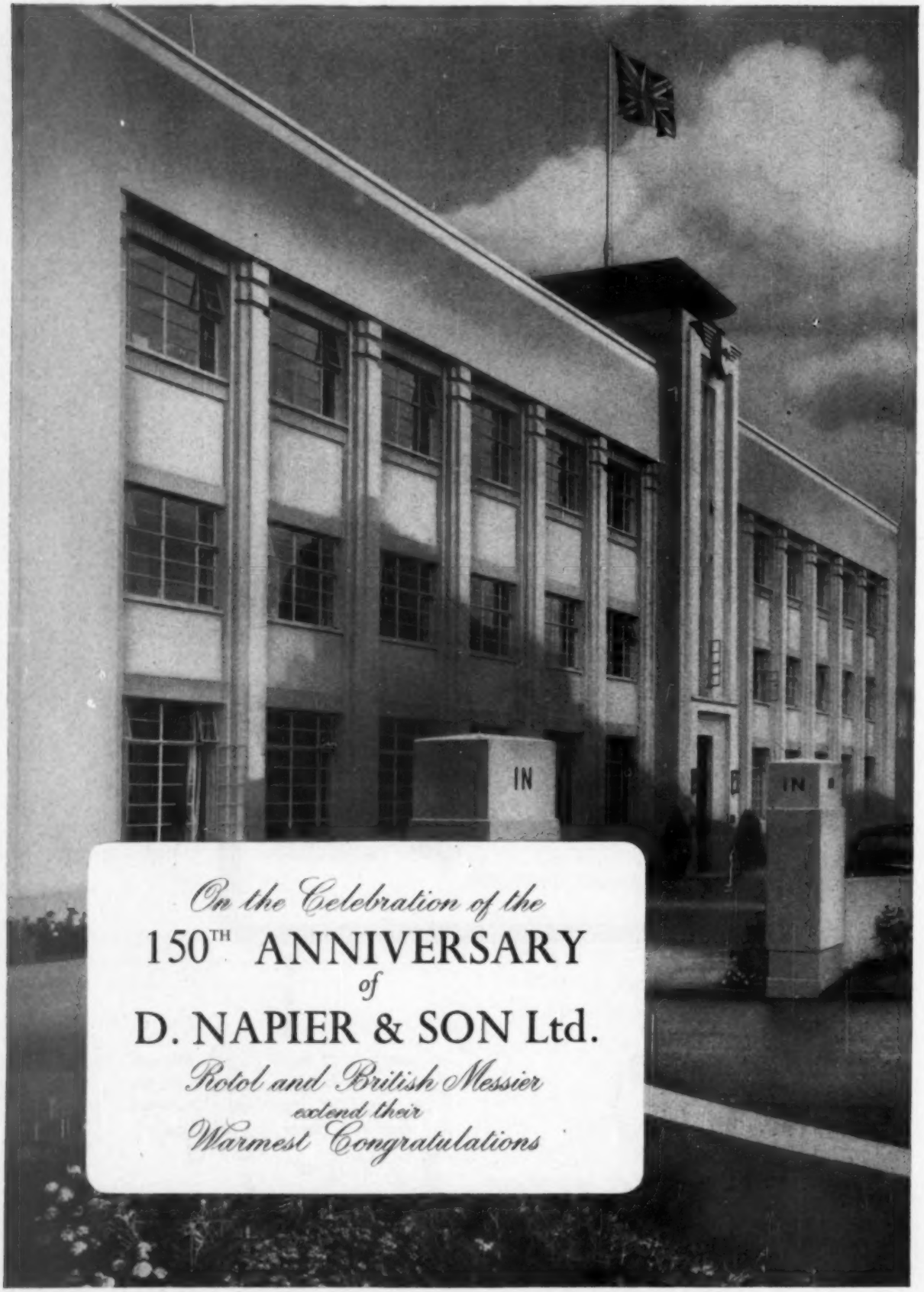

On the Celebration of the

150TH ANNIVERSARY

of

D. NAPIER & SON Ltd.

Rotol and British Messier

extend their

Warmest Congratulations

FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER

No 2579 Vol 73 FRIDAY 27 JUNE 1958

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Service Transport

DURING the last two weekends some 4,500 men have been flown to Cyprus by R.A.F. Transport Command, assisted by Coastal Command. This operation was carried out efficiently, but not with any warlike speed. Whatever the schedule may have been, it took five days to move the first 2,600 men; and in five days a great deal can happen in modern warfare.

Each operation of this kind—whether an emergency or an exercise—shows up our woeful lack of suitable military transport aircraft. Comets are fast, but are virtually limited to carrying men rather than material; Britannias will likewise be restricted in their military usefulness by their lack of a rear-loading facility; Beverleys, while able to carry any type of load, are, for all their virtues, lacking in speed and range for true "strategic" operation. There is nothing in Transport Command's possession comparable in versatility with the U.S.A.F.'s C-130 and C-133. When A.V-M. W. H. Kyle spoke on the R.A.F.'s equipment needs at the Prospect Two conference he said that there was a strong case for "a long-range large freighter," and he added: "If this is accepted we must make a start now and develop a military long-range transport which at the present moment seems to have no place in the civil inventory." He also added something which was not in the circulated version of his text: "Maybe we can buy in the foreign market to tide us over a difficult period."

This, surely, is a "difficult period"—from every point of view. Might not the R.A.F. buy C-130s as the R.A.A.F. has done? Or could it not have some on loan?

That is a short-term solution; and as a long-term one the Command might form a development squadron to work-up suitable types being produced or offered by British manufacturers—the VC.10, the Blackburn B.107 or Short/Bristol P.D.18, and A.W.A. Freightercoach. This work would be of inestimable benefit to the R.A.F. and to the constructors—and to the Army, which wants to be taken quickly in large numbers anywhere in the world.

When A.V-M. Kyle said "we must make a start now," the implication was that if we did so we might have the aircraft we wanted in five or more years' time. With the R.A.F. doing development flying this time-lag could be shortened.

Up Fares, Down Traffic

IN these days it is taken so much for granted that air traffic increases in volume each year that it comes as a shock to hear of traffic actually declining. Yet this is what happened in America during the month of May 1958, according to figures just released by the U.S. Air Transport Association. Compared with May 1957, domestic passenger-miles fell by 2.5 per cent. Even more disturbing was the fact that the load factor dropped by no less than 4.35 per cent.

How did this happen? There were probably three causes: the general business recession in the U.S.A.; the deterrent effect of recent collisions; and, above all, the influence upon traffic of last January's 6.6 per cent fare increases—as predicted in *Flight* of February 7.

The U.S. domestic airlines, having over-reached themselves financially in their orders for new turbine equipment, have clamoured and clamoured for higher fares. The Civil Aeronautics Board have refused to be browbeaten, saying in effect that fare-increases—because of their adverse effect upon traffic—could easily render redundant the big-capacity aircraft which the fare-increases are intended to pay for. Last January, however, the 6.6 per cent "emergency" increase was granted, pending completion of a full "general passenger fares investigation" (now in its eighth month). The result was a fall in traffic.

There is only one authority in the world which insists that the long-term prosperity of air transport depends upon lower fares—and that authority is the C.A.B. There is a fundamental lesson for everyone to learn from America's domestic air traffic figures for May 1958. Airlines are not always their own, or the public's, best advocates.

FROM ALL QUARTERS

London-Malta Record Claimed

A NEW London - Valetta (Malta) air speed record has been set up (subject to confirmation) by a Vickers-Supermarine Scimitar, flown by Lt-Cdr. D. F. Robbins of the R.N. Test Squadron at Boscombe Down, whose time for the official distance (1,298 miles) was 2 hr 12 min 27.2 sec—an average speed of 588 m.p.h. The previous best time was set up in 1949 by four F.A.A. Sea Furies, which took 3 hr 20 min 49 sec.

NEW RECORD for the London - Malta run, 2 hr 12 min 27 sec (588 m.p.h.), was established by Lt-Cdr. D. F. Robbins, R.N. (right), on June 18. He flew a Vickers-Supermarine Scimitar F.1 (see first item).

Wessex Takes the Air

THE first pre-production Westland Wessex, completed five months ahead of schedule, began its flight trials last Friday, June 20. Three days later Press representatives were invited to Yeovil to see it demonstrated by W. H. ("Slim") Sear, chief test pilot, with Gerry Smallridge as flight observer. The Wessex was put through the full repertoire, leaving no doubt that it is a helicopter of the liveliest disposition, particularly in the matter of steep climbs, steep turns and startling mid-air decelerations. Sear rounded off his show by driving the aircraft 200 yd or more along the ground—backwards and, without pausing, taking off backwards. Altogether it was a most convincing demonstration of the capabilities of the Wessex and its Napier Gazelle free-turbine powerplant.

Bell VTOL Progress

IT was announced by the Bell Aircraft Corporation on June 19 that the X-14 VTO research aircraft has become the first American jet aeroplane of conventional configuration (i.e., not a tail-sitter) to rise and descend horizontally. It is powered by two Armstrong Siddeley Viper turbojets, the efflux from which is deflected downwards during take-off and landing (picture, *Flight*, July 5, 1957).

The Nuclear Princess

THREE representatives of Saunders-Roe, Ltd., are going to Pratt and Whitney Aircraft to continue the investigation of the possibility of installing a nuclear propulsion system in a Saro Princess flying-boat. They are Mr. W. T. Peters, chief draughtsman, and Mr. C. Gaar and Mr. E. Timmins, two of his colleagues. An American team has just returned to the U.S.A. after visiting Saunders-Roe. The investigation is being carried out under a study contract from the U.S. Navy.

Aero-engine Exports

DURING the first four months of this year aero-engine exports earned, on average, £900,000 a week in overseas currency. Comparable weekly rates for similar periods in 1955, 1956 and last year were respectively £376,000, £511,000 and £688,000.

Total exports of aero-engines from January to April amounted to £15.5m, which represents an annual rate of £46.5m—compared with last year's record figure of £40.6m. If the total of £46.5m is attained, it will be more than double the annual totals for 1953-55 inclusive and five times the 1951 and 1952 totals.

Commonwealth IRBM

DURING a recent visit to Port Hedland—the point where the line of the extended Woomera missile range crosses the north-west coast of Australia—Mr. Athol Townley, the Australian Minister of Supply, made a brief statement regarding the IRBM being developed under the management of de Havilland Propellers, Ltd. Referred to as "the British Blue Streak," the weapon was stated to have a range of 2,000 miles, a speed of 10,000 m.p.h. and to be designed for launching against targets with a diameter of 30 miles. Mr. Townley said that Woomera would handle all the tests of the IRBM, which would last four to five years.

"Flight" photograph

Bloodhound Abroad

THE Bristol/Ferranti Bloodhound will shortly make its first appearance abroad, at the NATO air displays to be held at Liège, Belgium, and at Soesterberg in Holland. With the collaboration of the Ministry of Supply and the Air Ministry, the weapon, together with its transporting and loading trolley, will be air-lifted from Filton to Royal Air Force station Wildenrath, Germany, and from there to the displays, where it will appear among the R.A.F. exhibits in the guided weapons sections.

Cyprus Airlifts

TWO large-scale airlifts of troops to Cyprus from Lyneham and Abingdon R.A.F. stations have taken place during the past two weekends. Comets, Hastings and Beverleys of R.A.F. Transport Command and Shackletons of Coastal Command were engaged in the first, transporting over 2,600 men of the 16th Independent Parachute Brigade Group and associated Army units. In the second, which started on June 20 and ended last Monday, about 2,000 men of the 1st Guards Brigade and their equipment were transported. The same four types of aircraft were employed.

Round the States in 18 hr

A DEMONSTRATION flight around the United States in what is believed to be a record total time of 18 hr and a flying time of only 15 hr was completed on June 18 by a Bristol-Orpheus-powered Lockheed Jetstar.

Taking off from Edwards A.F.B., Cal, it flew north over the western States to make its first stop in Washington, headed east to make a second in Massachusetts, then south over the eastern seaboard to make its third in Florida.

The Jetstar returned to Edwards A.F.B. from Florida, having made its circuit of the U.S.A. at an average speed of 385 kt (440 m.p.h.).

Lord Kindersley's Review

IN his statement to shareholders of Rolls-Royce, Ltd. (published in advance of the a.g.m. on July 15), the chairman, Lord Kindersley says that the increase of £11m in total trading revenue for 1957—to a record figure of £91m—was almost entirely attributable to deliveries of aero-engines for civil airlines and overseas Governments, these being the result of orders taken in prior years and of research and development originating many years ago. He stresses the need for future Government support for the aero-engine industry, so that its share of the overseas market can be sustained.

Lord Kindersley emphasises the importance to the exporting industry as a whole of the Government's efforts to bring stability to our national economic scene; but since the Defence White Paper "finally defined the change of emphasis from the provision of equipment for the fighting services to the fiercely competitive business of selling aircraft and engines in international markets," the output of British civil aircraft must be encouraged to grow considerably if it is to provide the turnover to sustain an adequate programme of engine development: "Even with our military programmes today we are dependent upon exports for more than 50 per cent of our total engine production, and a substantial part of this is represented by sales of military equipment to foreign Governments. If the domestic effort on military types is to decline, this market will inevitably go to the U.S.A."

BEFORE THE PARTY: Sir Arnold Hall and Lady Hall receive Maj. G. P. Bulman (left) and Mrs. Bulman at the Royal Aeronautical Society garden party (see p. 884). Maj. Bulman is a former R.Ae.S. president.

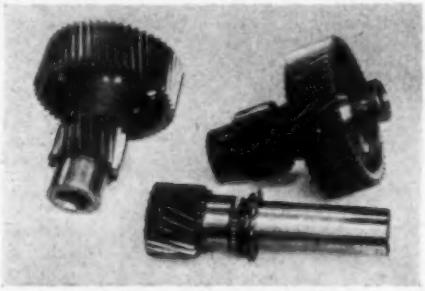
Defining this as "the nature of our problem," Lord Kindersley adds: "We are encouraged to know that the Government are giving the subject their earnest consideration." In suggesting forms which practical assistance might take, he says: "The maintenance of basic aerodynamic research, the fostering within the engine companies of research . . . aimed at extending our knowledge of the art, co-operation from Transport Command in the flight testing of new products [a matter referred to in our leading article on service transport, p. 879—Ed.]—these are but a few examples of the kind of support which should not be in doubt."

Rolls-Royce show a profit (after taxation) of £2,320,334 for 1957, compared with £2,130,543 for the preceding year. The accounts, which were briefly referred to in our issue of May 23 (p. 724) are published in an admirably clear and readable form.

3,200 s.h.p. Dart

IT is announced by Rolls-Royce, Ltd., that a Dart RDa.10 turboprop has successfully completed a 25-hr flight approval test at a military rating of 3,200 shaft horsepower using water/methanol to provide take-off boost. The normal rating of the engine is 2,650 s.h.p.

In several respects the flight approval test was more stringent than the schedule normally required; Rolls-Royce cite the fact that 56.6 per cent of the test was run at maximum continuous power although the normal type-test schedule specifies 30 per cent. The test was officially observed by the A.R.B. and was undertaken to demonstrate that the RDa.10 can be approved at 3,200 s.h.p. for flying in prototype aircraft.



3,200 SHAFT HORSEPOWER: As described in the accompanying news-item, this is the power delivered by a military Rolls-Royce Dart turboprop during a recent type-approval test. Indicative of the excellent strip of the engine is this photograph of part of the reduction gear.

Two of the chief military applications of the Dart concern the Bréguet 1050 Alizé anti-submarine aircraft and the Armstrong Whitworth AW.660 transport. In existing Dart applications water/methanol is used merely to restore the rated take-off power in adverse conditions of altitude and/or temperature, but the military RDa.10 employs the mixture to provide an increased rating. The condition of the engine upon stripping is described as excellent, and an accompanying photograph depicts part of the reduction gear.

Conrad Does it Again

IN a Piper Comanche, Max Conrad—nicknamed the flying grandfather—flew from La Guardia to Palermo, Sicily, last Monday in 32 hr 55 min, covering 4,950 miles at an average of 150 m.p.h. The flight was routine except for the radio failure over the Bay of Biscay, caused when Conrad broke a wire with his foot. He decided to fly low to avoid other traffic, but was misunderstood, and rescue services were alerted. Three seats had been removed to make room for extra fuel tanks. Conrad had previously ferried several Apaches non-stop from New York to Paris.

"H.P." on Government Policy

THE views of Sir Frederick Handley Page on the future of the aircraft industry are expressed in his address to shareholders of Handley Page, Ltd., issued in advance of the a.g.m. on July 16. He says:—

"Undoubtedly, the industry should be strong enough to meet (and beat) the competition of its overseas rivals in terms of technical ability, productive capacity and financial strength. This, though, will not be achieved by coercion to force amalgamation between its constituent units.

"A private-enterprise industry is better left to form its own groupings to meet future needs—as it has done successfully in the past. Your own company's experience in two great wars is an example of this.

"The various official statements that have been made both within and outside the House of Commons need now to be translated into more precise specification terms so that the British aircraft industry may organize itself accordingly. When such requirements are known in relation to its civil-aircraft commitments and opportunities, the industry can go ahead with such re-organization, if any, which may seem desirable to improve its technical, productive and financial resources.

"It is unreasonable to expect the present constituents—whose capacity is regarded as too big for the likely amount of aviation work—to re-group themselves into even more powerful and productive units if they are not enabled to assess the work for them to do in the future. Indeed, some of them may choose instead to move entirely outside the industry into realms where the risk is less and the demand for products is more certain and constant."

Of progress with the Victor, Sir Frederick recalled that in the year under review (to December 31, 1957) it had flown supersonically on a routine test flight and was the largest aircraft in the world to have done so. Victor Mk 1 production would be followed by that to fulfill the Mk 2 orders. With Rolls-Royce Conways of 17,250 lb thrust the Mk 2 would be even more powerful than the Victors at present in R.A.F. service, and they would be equipped with the stand-off bomb. Sir Frederick continued:—

"The outstanding aerodynamic performance of the Victor has made possible the carrying of more of the latest equipment which has been under simultaneous development by other specialist companies for the Ministry of Supply. This has been issued to us for installation and has placed the Victor still farther ahead in its class.

"Unfortunately the modifications involved caused a considerable setback in production and in final delivery of the Victors; there was a consequent congestion of completed but unmodified aircraft. The cost of the actual installation of the modifications does not in fact cover the whole expense involved. Such a setback delays output and leads to increases in the value of work in progress and the finance needed to carry through production. Its effect is seen in the financial results for the year, no provision being included in the accounts for a claim that has been preferred in respect of the cost of this setback. Victor deliveries are now proceeding in accordance with our agreed programme."

Of the Government's attitude to the export efforts of Handley Page (Reading), Ltd., with the Herald branchliner, Sir Frederick has this to say:—

"It might be expected that in support of our endeavours in the export market we might have had, in addition to expressions of official goodwill, the Government's active assistance bestowed upon us. In fact, apart from technical help in the form of wind-tunnel facilities, your company has had no practical sponsorship in its efforts to provide a British replacement for the 700 war-vintage foreign aircraft still plying the short-range air routes of the world. This would seem to be extreme shortsightedness on the part of those whose business it should be to do everything possible to encourage a promising exporting venture which could bring in much foreign currency."

Handley Page financial results for the year show a group net profit of £127,870, after providing £188,837 for taxation.

PARADE of Bristol Sycamore utility helicopters (Alvis Leonides engine) for the German Armed Services. Of 50 ordered nearly 30 have been delivered. In this line-up, at Weston-super-Mare, the machines in the foreground are for the German Navy.

BELOW DECKS in a Blackburn Beverley, these men of the 2nd Battalion, Grenadier Guards, are about to leave Abingdon for Cyprus. The airlift is referred to in a news-item on the opposite page.

LIGHT MILITARY TRANSPORT possibilities of the Miles H.D.M. 106 Caravan—including the parachuting of equipment with the rear loading door removed—were recently demonstrated to Service representatives by the smaller H.D.M. 105. Appropriately for this Anglo-French design, one of the two dispatchers was a French Army officer.

FROM ALL QUARTERS . . .

British Parachute Team

BRITAIN is to be represented by four parachutists—Miss Sue Burgess, Mike Reilly, and Sgts. Joe McLoughlin and Denis Lee (from R.A.F. Boscombe Down)—in the international parachute-jumping contests at Bratislava, Czechoslovakia, August 1-16. The members of the British team (plus one other parachutist) are to give a demonstration jump at the National Air Races, Baginton, on July 12.

VTOL Simulator

ILLUSTRATED on this page is the ingenious simulator, taking the form of a dynamic test-rig, which Short Bros. and Harland have designed for pilot training and systems-testing in connection with the SC.1.

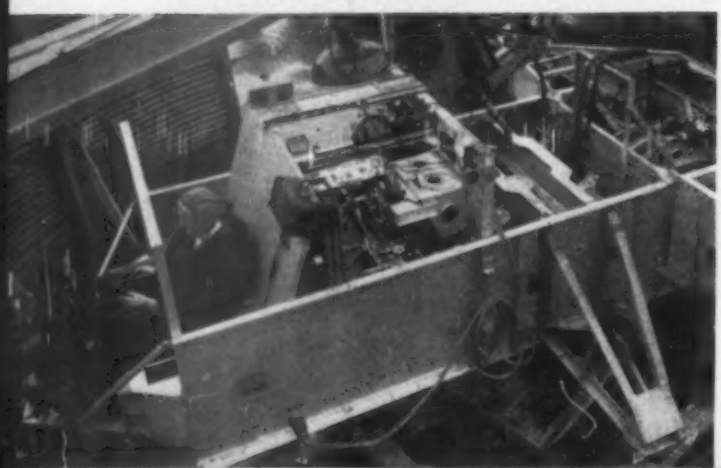
The device will not only familiarize pilots with the characteristics of the aircraft but will also be used for the functional testing of the hydraulics and electrics, auto-stabilizer, elevator power control and air nozzle systems.

The rig consists basically of a skeleton framework, in which the appropriate components are mounted, and the entire structure is supported by an "air bearing" which permits the rig to move virtually without friction, on a cushion of compressed air. Systems, services and instruments are duplicates of those used in the actual aircraft. Recording instruments for functional testing are installed in a separate room and connected to the rig by overhead cables. At a later date it will be possible to operate the rig remotely from this control room, either manually or by signals fed from a Short analogue computor.

Although no engines are mounted on the rig, ducting and air-jet control systems are identical with those of the SC.1, the necessary compressed air being supplied by either a modified Rolls-Royce Avon or Nene housed in an adjacent building. The air is ducted through a central hole in the spherical air bearing to a distributor head on the rig. To avoid adverse ground effects, however, the control nozzles in the wing-tips, tail and nose—which, in the aircraft provide lateral and longitudinal stability—are inverted on the simulator to exhaust upwards; compensation is made by incorporating reversing links in the control circuits and correcting the autostabilizer accordingly. Aileron and elevator control surfaces are simulated by torsion bars and masses, representing respectively load and inertia. The rudder is not represented.

Rig trials will include special emergency tests, in one of which the results of a failure in one of the SC.1's four vertical-lift engines will be simulated. This will be achieved by moving a mass on the simulator to give an out-of-balance moment equal to the displacement of the vertical-jet thrust-centre, and at the same time shutting one of the ports in the air distributor head.

FLOATING ON AIR: The Short SC.1 simulator and test rig, described on this page. At the controls is Mr. H. G. Conway, the company's joint deputy managing director and chief engineer.



Aero Research Changes Name

A NAME familiar in the industry for the past 24 years will no longer be heard after June 30. It is that of Aero Research, Ltd., of Duxford, Cambridge, who on June 30 will change their title to CIBA (A.R.L.), Ltd.

The company, which was formed in 1934 for research into aircraft structures, including the development of adhesives, explains in the following words the reasons for the change, adding that the names of their products Aerolite, Araldite and Redux remain unaffected:—

"In the last twenty years the range and extent of the company's activities have radically changed and the name of Aero Research is no longer appropriate in view of the many industries served by its products. The time is thought opportune to introduce a new name having associations with the past but emphasizing affiliation to the world-wide CIBA organization. This organization has had almost 75 years' experience in the manufacture of chemicals and produces dyestuffs, textile auxiliary products, pharmaceuticals and chemicals for pest control, in addition to plastics."

IN BRIEF

Ceylon is to buy ten British aircraft under an air expansion programme. Six Jet Provosts, two Doves and two Prestwick Pioneers have been specified as probable purchases.

* * *

Contracts for Project Dynasoar—a manned space-craft which "will be launched like a rocket, will orbit like a satellite and return to land like a conventional aircraft"—have been given by the U.S.A.F. to the Martin and Boeing companies.

* * *

Mr. C. S. Thom has been appointed by de Havilland Holdings, Ltd., to assist in co-ordinating the export and other overseas interests of the D.H. companies and has relinquished his position as sales director of the de Havilland Aircraft Co., Ltd.

* * *

Two American members of the crew of Sir Charles Kingsford-Smith's *Southern Cross* when it made the first trans-Pacific flight in 1928, Mr. Harry Lyon and Mr. James Warner, are to attend the ceremony at Brisbane Airport when the aircraft will be unveiled in a new memorial building.

* * *

Maj. Alford ("Al") Williams, former U.S. Navy chief test pilot who in 1923 set up a world air speed record of 266 m.p.h., died on June 16 in Elizabeth City, N.C., at the age of 67. One of the aircraft he flew—the Grumman Gulf Hawk—is displayed at the Smithsonian Institution in Washington as "the plane that taught young America to fly."

* * *

An exhibition of over 50 air-to-air photographs by Russell Adams, chief photographer of the Gloster Aircraft Co., Ltd., is being shown at the Camera Club, 23 Manchester Square, London, W.1, during July. The exhibition will be open on weekdays from noon to 10 p.m. and on Sundays from 3.30 p.m. to 9 p.m. and admission is free.

* * *

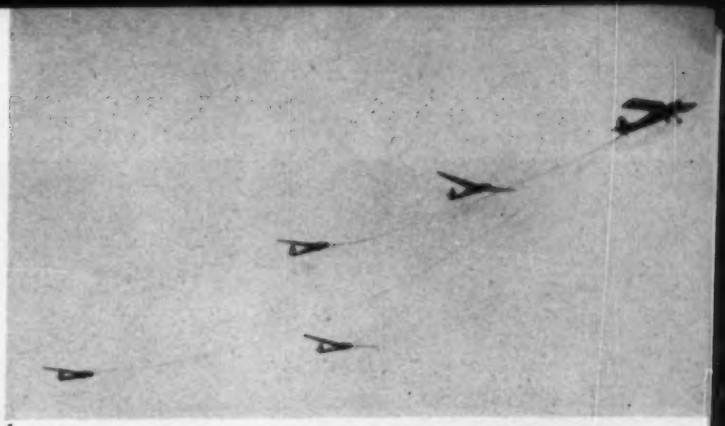
Representatives from the 16 specialist companies which make up the Hunting aerial survey group—in the U.K., Africa, Australasia and the U.S.A.—have been meeting in Toronto to pool their knowledge with their Canadian colleagues. New techniques in precision mapping from aerial photographs, airborne mineral prospecting and the integration of inventories of the world's natural resources were among the subjects discussed.

* * *

Following 21 hours of flight testing by André Turcat, chief test pilot of Nord Aviation, the Smiths SEP.2 autopilot has been accepted as standard equipment for Nord 2501 Noratlas being delivered to the German Air Force. Before flight trials began, autopilots from major manufacturers on both sides of the Atlantic were subjected to a thorough technical assessment and exhaustive analysis in order to select the most suitable. The SEP.2 fulfilled the military specifications; and it has now also been specified for the Noratlas to be delivered to civil operators.

KENNETH OWEN of "Flight," a member of the British Team in the International Gliding Championships (story pp. 891-892) photographed this

Polish Panorama



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(1) Four-in-hand: quartet of Mucha-100s towed by a Yak-12 at the opening display. (2) Two-in-hand: picturesque anachronism near Leszno Airfield. (3) Members of the Russian team. (4) Jaroslav Kumpost in the semi-reclining cockpit of the Czechoslovak Spartak. (5) Michal Zwieriow of Russia in his Jaskolka Z. (6) Only glider to be flown as a two-seater was the French Bréguet 904—front pilot Fonteilles, rear Marchand. (7) Parasolicitude for Daniel Barbera of France, Bréguet 901s. (8) One of the Junak 2 tugs (160 h.p. five-cylinder M-11RF), whose ultra-short tow-ropes surprised British competitors. (9) The opening ceremony as seen from the ranks of the British team; A. Gehriger, president of the F.A.I. Gliding Commission, is speaking.

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The Garden Party

"FLIGHT" PHOTOGRAPHS

1

(1) Taxying out for take-off is the Gloster Gladiator, last of its noble breed, and restored in the authentic markings of Gladiator K8032 of No. 72 Squadron, R.A.F. (2) Flying the Gladiator was Gloster's chief test pilot, R. F. (Dickie) Martin. (3) Fairey test pilots with the side-by-side Tipsy 2 are Gordon Slade and David Masters. (4) One of the two Thruxton Jackaroos (four-seat Tiger Moth conversion) on show was G-ANZT, flown by Capt. D. W. Phillips. (5) Tied together for formation aerobatics are seen three of the eight Tiger Club members. Also demonstrated was the "hot-rod" single-seat Tiger Moth special, The Bishop. The original Fairey Fulmar is in the foreground. (6) Oliver Tapper shows off de Havilland's 1925 D.H. Cirrus Moth; in the foreground are the A.A.'s D.H. Dragon Rapide and G. Rolls' Vega Gull, G-AEYC (shown at the 1939 Garden Party). (7) Low-level beat-up by Jeffrey Quill in the Spitfire, which had just dog-fought the Hurricane (Bill Bedford).

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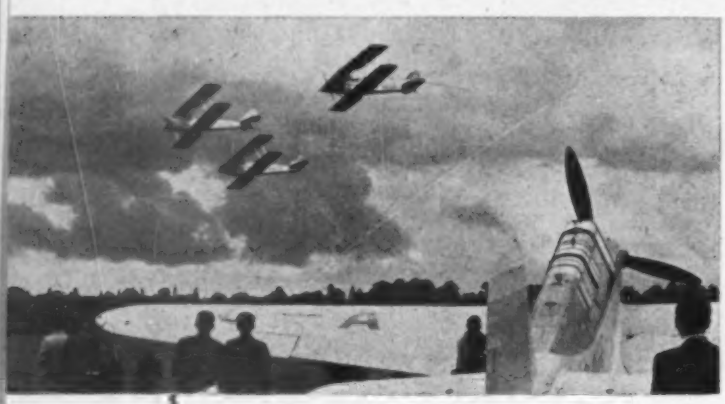

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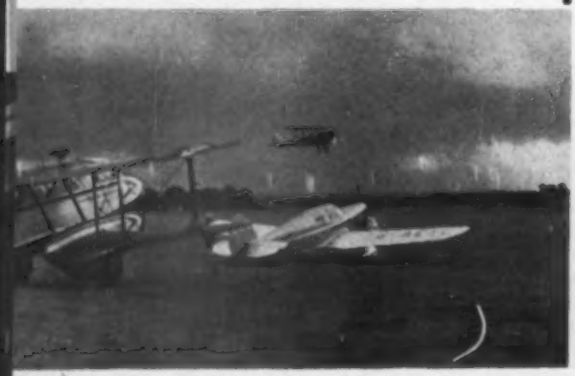
BY a meteorological miracle White Waltham Aerodrome was spared the torrential downpour which lashed most parts of southern England all day last Sunday, June 22. Though a lightning-charged, blue-black curtain of rain menacingly threatened the aerodrome throughout the afternoon, scarcely a drop touched the 70-odd aeroplanes and 3,000 people attending the Royal Aeronautical Society's annual Garden Party.

This year's hosts at British aviation's most sociable social function were Faireys. Guests were received, as is the custom, by the R.Ae.S. president and his lady—who this year are Sir Arnold and Lady Hall. (See picture on page 880.)

The flying display was a high-spirited, pleasing blend of nostalgia and modernity, 45 aircraft taking part. The hangar exhibition was well presented, the Fairey Rotodyne VTOL airliner holding court to a display which—a trifle inappropriately perhaps—was dominated by missiles. Alas, the Nash and Shuttleworth veterans were not this year on show. The published programme maintained the customary high traditions of letters and wit; the commentary was by Alan Brothers of English Electric, and the flying was managed by Peter Twiss of Faireys. Music was provided by the Fairey Aviation Works Band.



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"Cut!" signals the marshal

IT'S THE END of another flight — but the beginning of a busy time for the maintenance staff.
Quick turnround needs careful planning, and the *on-the-spot* facilities provided by Goodyear Airline Service are an essential link in this. Appreciated by major world airlines and charter companies, this Goodyear service is organised to ensure fast turnround of aircraft and to help maintain regular schedules with safe, economical operation.
The Goodyear Tyre & Rubber Co. (G.B.) Ltd., Wolverhampton
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GOODYEAR AVIATION DIVISION

SERVING AVIATION THE WORLD OVER

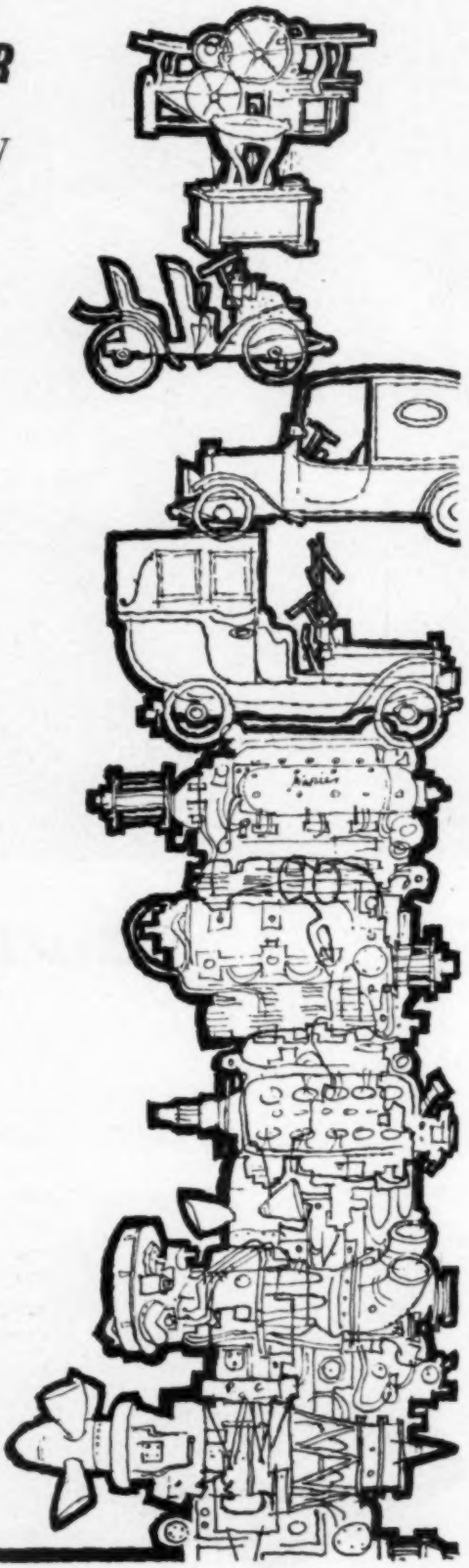
Congratulations to *NAPIER* on 150 years of enginuity

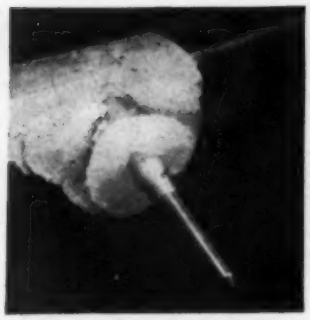
1808 to 1958

Hail first the 'Nay-peer' printing press
Heralding, with immense success,
A splendid sequence of invention
Which we have barely space to mention!
Engines designed to turn out guns
And weigh gold coins out in tons—
And more to squash up, flat and neat,
Astonishing amounts of peat.
Then came the cars . . . and soon 'twas found
That NAPIER's feet had left the ground.
The famous LION began to soar
Where never Lion had roared before,
Then CUTLASS, CULVERIN and RAPIER—
You couldn't get away from NAPIER!
Soon JAVELIN was in the air,
DAGGER and SABRE too were there,
NAIAD and NOMAD came to swell
The list, and ORYX and GAZELLE.
And men from Bootle to New Zealand
Were full of praises for the ELAND;
While others pinned their hopes upon
The mighty DOUBLE SCORPI—ON!
(We're sorry—*we* deserve a rocket
For pulling that one from our pocket.)

But all we really want to say
To NAPIER is: 'Hip, hip, hooray!
You must be feeling pretty good.
And so—by all that flies—you should!'
Which brings to us this final thought
(Go on, keep reading! Be a sport!)
What engines such as these deserve is
The

AVIATION BP SERVICE





"The parts of pitot heads subject to icing conditions can best be tested in icing tunnels"—a telling illustration from Mr. Le Sueur's paper.

Discussing De-icing

USEFUL FACTS EMERGE FROM CONFERENCE AT LUTON

AN all-day conference on aircraft icing, which was attended by representatives of the leading aircraft, aero-engine and accessory firms and interested Government establishments, was held at Luton Airport, Bedfordshire, on June 11, under the auspices of Napier's flight development establishment, itself the originator of a well-known aircraft de-icing system. The conference, said to be the first of its kind ever held in this country, was presided over by Mr. C. L. Cowdrey, manager of the flight development establishment; and the chairman was Mr. R. D. Crick, Napier's chief de-icing engineer.

Five papers were read and each was followed by a short discussion. The first was by **Mr. H. E. Le Sueur,** of the Air Registration Board, whose subject was *Icing Standards and Methods used to Determine the Suitability of Aircraft to Fly in Icing Conditions.*

In interpreting the official requirements, said Mr. Le Sueur, it had to be borne in mind that, whatever the severity of the icing conditions, the propulsive units and essential instruments should still continue to function satisfactorily. The airframe should be able to carry a certain amount of ice without hazarding the lives of the occupants, and the engine(s) should be able to digest a certain amount of ice without malfunctioning.

Propeller protection should keep vibration to a minimum and maintain a high percentage of propeller thrust. Windscreens should be protected so that the pilot's forward view was never impaired, and all excrescences, including radio aerials, should be strong enough to support some ice.

Recent tropical experience had led the A.R.B. to revise some of its earlier assessments, and the following table, showing total water content of clouds at altitudes near or above the freezing level, would shortly replace the current table:—

Temperature range (deg C)	Altitude range (ft)	Maximum total water content (gm/cu m)	Extent (miles)
0 to −20	10,000–30,000	8.0 5.0 2.0 1.0	0.5 3 50 100 plus
−20 to −40	15,000–40,000	5.0 2.0 1.0 0.5	3 10 50 100 plus
−40 to −60	20,000–45,000	2.0 1.0 0.25	3 10 100 plus
−60 to −80	30,000–60,000	1.0 0.5 0.1	3 10 100 plus

Note: The values in the maximum total water content column include ice crystals and liquid water, but not water vapour.

Mr. Le Sueur stressed the point that, although an aeroplane might be able to operate in the severest of these icing conditions, it should not, because of turbulence and hailstones (some of which might be of 5½in diameter) fly into the heart of a tropical thunderstorm. Radar warning equipment would ultimately reduce this risk.

Natural icing conditions were not easy to find; in consequence, flying test-vehicles, test-beds at the tops of mountains or in very cold climates, icing wind-tunnels, high-altitude simulating plant, and cold chambers, had often to be resorted to in the testing of equipment. However, an aircraft's ability to remain controllable while carrying one to two inches of ice had to be demonstrated in natural conditions.

Whether or not an ice detector was a necessity remained unresolved. A reliable instrument, the lecturer said, would give the crew warning, but when equipment could tolerate no delay or, conversely, when it could tolerate a long delay, the device was not needed. In certain other conditions, it was very desirable.

The second paper was read by **Mr. W. Sherlaw,** of Rolls-Royce, Ltd., who dealt with *Some Aspects of Engine Icing.* The problem of piston engine protection, he said, had been solved by heating the air entering the engine, and that was to have been the Rolls-Royce solution for the turbine engine. But eight years of development and artificial icing spray grids had broadened their education.

The Avon turbojet, the lecturer said, was protected by hot gas, and the Dart turboprop by an electrical system. The Tyne turboprop, too, would have an electrical system. He then gave details of some of the methods of de-icing and anti-icing with which Rolls-Royce had experimented. The attempt to heat incoming air on the turbine engine had produced a system which resulted in a permanent loss of two to two-and-a-half per cent of the total power, and one of nearly 30 per cent in icing conditions! Pastes and fluids, methanol and alcohol injection, momentum separation and mechanical methods had also been tried.

The company had tested various ice detectors, but still had to find one which would indicate ice immediately from a trace at any altitude, speed or temperature, and not "cry wolf," and at the same time be reliable.

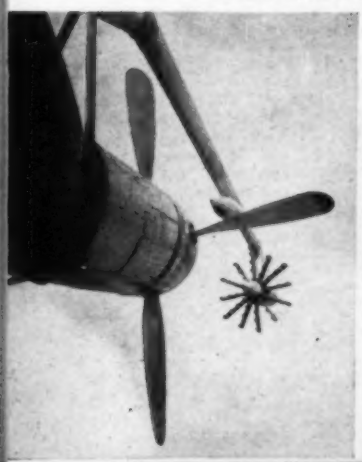
Mr. J. A. Hay, of Vickers-Armstrongs (Aircraft), Ltd., posed in his paper the question: *Electrical or Hot Gas Thermal Ice Protection?,* and after briefly reviewing the processes of ice formation, proceeded to assess the merits and drawbacks of the two systems as seen by an aircraft manufacturer. He based his comparisons on a typical aircraft with some 1,500 sq ft of wing area, powered by four turboprops or turbojets. His comparisons dealt with structural limitations, installation problems, weight, control, aircraft performance penalty, serviceability and maintenance.

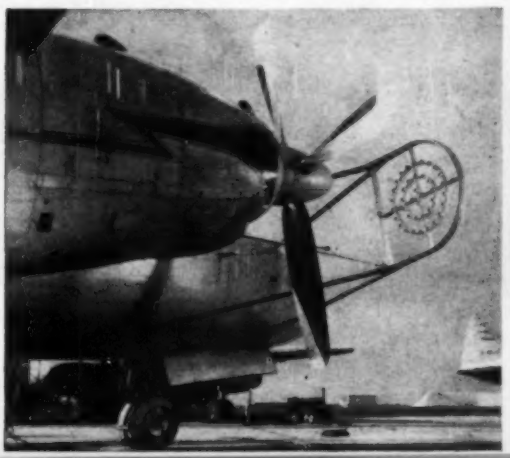
He was of the opinion that hot gas was to be preferred for the protection of the mainplanes, and an electrical system for that of the tailplane—a conclusion which was supported by the steadily increasing number of aircraft on which the two systems were used in this way.

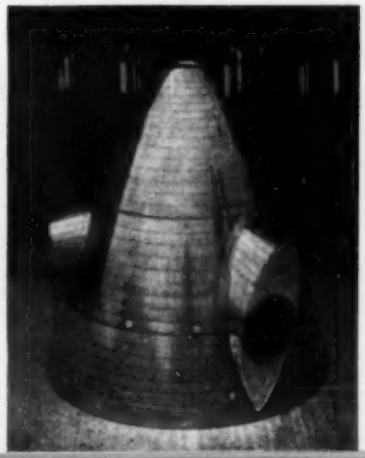
The fourth speaker was **Dr. R. A. Roper,** of Napier, whose paper was entitled *Aircraft Electrical Ice Protection and Future Developments.* The electrical system, Dr. Roper said, might consist of wire in rubber, foil in rubber, sprayed metal or foil in resin, or similar combinations. Its thermal efficiency was highest when the base coat of insulating material was thickest and the top

(*Continued on page 890*)

Two interesting intake-icing rigs illustrated by Mr. Le Sueur, for the Naiad in the Lincoln test-bed and for the Eland-Varsity. On the right, from Dr. Roper's paper, is a demonstration of how neatly electrical heater-mats can be applied to complex surfaces.

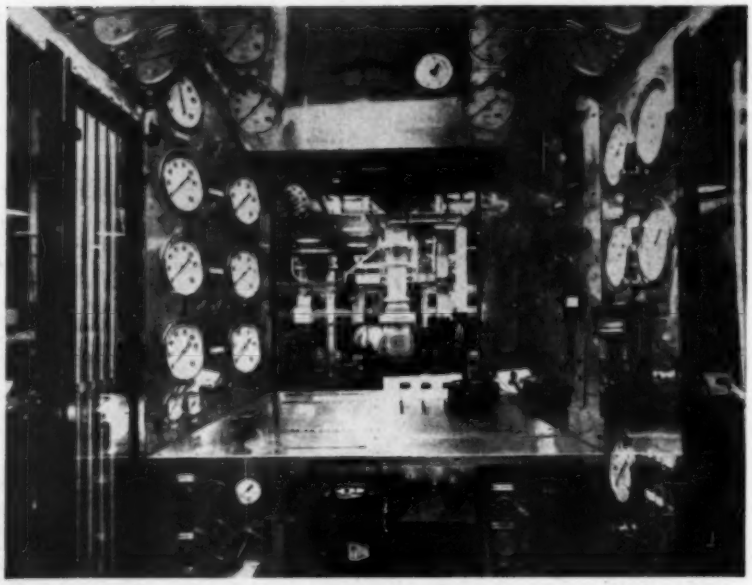






A Service to Industry

GAS TURBINE EQUIPMENT FOR NOW AND TOMORROW



One of the nine control and instrument panels used by Joseph Lucas (Gas Turbine Equipment), Ltd., in combustion chamber research. The associated rig can be seen through the window.

ONE of the facts of life of the aircraft component industry is the impossibility of going it alone. Equipment manufacturers have always been closely tied to the aircraft and engine constructors they supply and they are inevitably dependent upon the prime contractors for their business. Thus when, as today, the competitive temperature within the aircraft and engine industry is rising, the component industry must be among the first to meet the challenge. On every hand, the tapering-off of Ministry support has thrown the industry upon its own resources, and the focus of interest among the component manufacturers is now more than ever upon the way in which individual firms are adjusting the fine balance that exists between technical adventure and commercial realism—with the risks attendant upon being over-reactionary.

One of the ways in which this thorny problem can be tackled is to decrease the degree of specialization that has been demanded during the last few years. There is already a clear trend within the auxiliary industry for a much greater degree of diversification than has been the practice hitherto; few firms now serve only aircraft interests, because commercial work is urgently needed to expand the total business that is done. The commercial engineering world is happy to be served by the *expertise* that can be offered by the aircraft equipment industry; but the total volume of production must be high if aircraft development costs are to be spread thinly enough to offer commercial prices.

Even in aircraft work, for long a realm in which—if we are honest—it must be admitted that only lip service to price-cutting has been paid, cost competition is a growing influence on the thinking of design, engineering and production departments alike. It has often been possible in the past to bulldoze expensive modifications through M.o.S. local technical committees by propounding the technical merit of an improvement, and dismissing protests over cost with an impatience that anything should stand in the way of the best that could be devised.

In a purely civil market aircraft manufacturers are still willing to meet the cost of first-class equipment, but they will no longer do so without close examination of the product on a basis of value-for-money. The ultimate in technical refinement has always been exceedingly costly, since development and production costs rise in an almost exponential relationship to quality. It is not that any compromise can be made on the high standards that aircraft have always demanded, but that new methods must be devised of achieving them. Cost study must begin with the designer and continue with the development and production engineer.

The aircraft industry has often been both jeered at and envied for its comparative freedom from pennywise cost paring, but now those days are ending; a new and tougher brand of commercialism is permeating. Those who cannot or will not learn the new technique will be displaced by those who can.

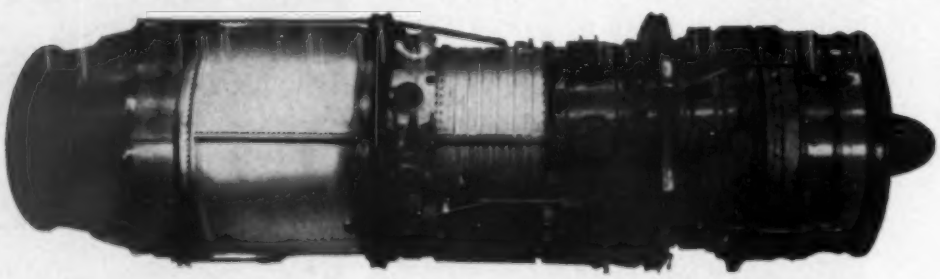
During a recent visit to Joseph Lucas (Gas Turbine Equipment), Ltd., at their facilities in Birmingham, Liverpool and Burnley, *Flight* had the opportunity of discussing with the firm the problems facing a concern whose efforts have always been directed to serving the aero-engine industry, and learning something of their thoughts and hopes for the years ahead.

With staff divided fairly evenly between the three factories, Joseph Lucas (G.T.E.) employs about 6,000 workpeople on the manufacture of fuel systems, pumps, combustion chambers and associated equipment for gas turbines. Although they have other interests in the industrial, aircraft hydraulic and missile fields, it is aircraft gas turbine equipment which will be the mainstay of their work in the foreseeable future.

There is a tendency for engine manufacturers to take combustion-chamber research and development work increasingly under their own wings, although on the extent to which this is likely those at Burnley and Birmingham differ slightly in their views. Engineers at the Burnley factory, where the chambers are developed and made, believe that the specialized knowledge and facilities that Lucas can offer in this direction would make it hardly worthwhile for engine manufacturers to undertake such development themselves, any more than they would attempt to make, say, turbine disc forgings.

The opposing point of view is that, in a development-cost-conscious industry, research and development capacity such as Lucas can offer for gas turbine research is a most difficult commodity to sell; and that unless the Burnley factory can, by great effort, keep an undisputed lead in this field, this side of their activities may dwindle.

Though displaying the gentlest possible manners, Lucas G.T.E. like to regard themselves as a commercially tough firm; they have always been ready to face the rough-and-tumble of competition and they accept without demur their position as auxiliary to the aero-engine industry, and the implication that they must be adaptable to that industry's needs—to the extent of being always prepared to make major changes to units at a late stage in development. The firm are unquestionably commercially successful and they attribute their achievement to their ability first of all to be tough with themselves. Perhaps because of their relationship with the vast Lucas electrical organization, the Gas Turbine Equipment company have always been particularly cost-conscious, and they have always believed in the value of selling on a basis of price as well as technical merit. The motor-industry practice of querying



The 16,000 lb thrust Bristol Olympus BOl.6 is one of many engines embodying Lucas fuel and combustion systems.

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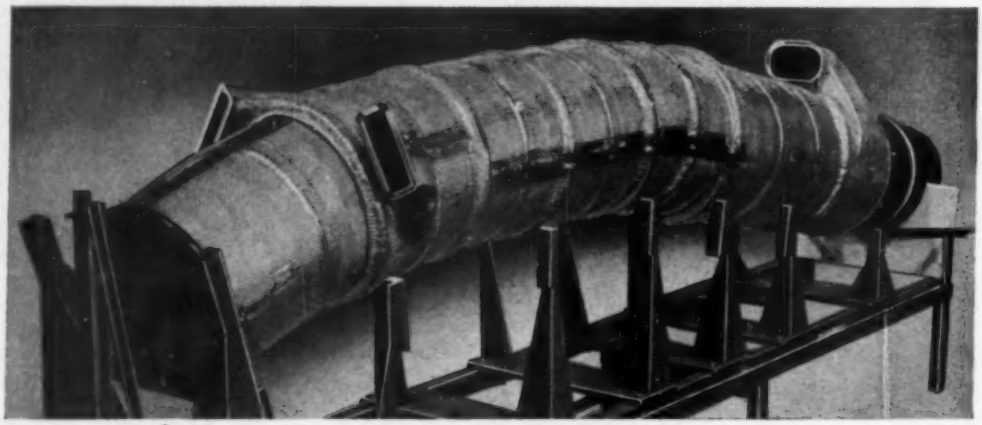

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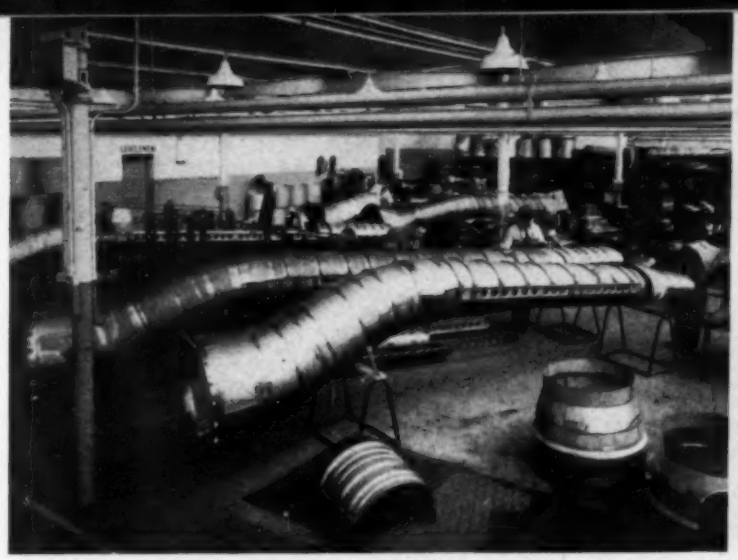

Intricate sheet-metal fabrication at Lucas, Burnley, is now a routine task. On the left are Britannia tailpipe shrouds—testimony to the degree of ductility imparted to titanium. Right, a special electric furnace permits single-operation heat treatment of 21ft long jet-pipes.

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every aspect of a design and production process from a cost standpoint has stood them in good stead. They claim that commonsense applied to their engineering methods—the maximum possible simplification, extensive use of common or similar parts and the ability, acquired with long practice, to detect unnecessary design-frills—has enabled them to face with equanimity a situation where cost control is of paramount importance; and, perhaps to an unusual degree, they have passed on to their customers the savings they have achieved.

It hardly needs repeating that the precision-component industry has always been faced with extremely high overhead costs. The reasons are not hard to seek. The manufacture of precision equipment requires an exceptional amount of special-purpose machinery per unit produced, and unless such plant can be kept fully occupied the high equipment-cost will be reflected in the cost of the unit.

The components industry has also long been bedevilled by the problem of how to cope with sudden demands from airframe and engine manufacturers for rush developments or design modifications made necessary by test experience. Only by providing excess capacity in the machine shop can this facility be easily obtained; only by *not* providing it can costs be reduced to a minimum. Much of the component industry's poor reputation for on-time deliveries is the result of this dilemma, and it cannot be foreseen that the situation will become much easier if the accent on lowest possible cost is to remain.

As a matter of policy, Lucas have never deliberately compromised on their viewpoint that shop loading should always be kept as high as possible. In their expanding years (the organization has grown rapidly in the six years since 1952) the firm have often been hard-pressed to meet the inevitable emergencies that have arisen, and modification programmes and work resulting from design-changes have had to be accommodated wherever excess capacity could be found. The size and scope of the organization and the use of sub-contractors have increased the chances of spreading an additional emergency workload, but there have still been occasions when deliveries have fallen behind the scheduled dates. Lucas are able to claim, however, that programmes have never had to be rewritten owing to their inability to supply at the required rate.

By working very closely with the engine manufacturer in the early stages of a design, the company are able to plan ahead and the delivery position has become easier than hitherto. By and large, they can offer delivery of a new system of unknown design within 18 months of its inception and hold the promised date to within a month. This is done by the familiar process of drawing-up programming charts for design, detail drawing, production and test. In exceptional circumstances it may be possible to condense the operation into a year, but the complexity of modern systems is such that this is very difficult to achieve.

The processes by which delivery dates can be accurately estimated and firmly maintained are still, in general, incompletely appreciated by the components industry. Lucas are reluctant to allow that on-time-delivery stems largely from an attitude of mind, because they feel that they have mastered the problem to an extent where only late-stage modification will seriously affect their programme. They appreciate—and it is suggested that they are unusual in this appreciation—that the only way to control test-and-development time on a new unit is to be reasonably sure that testing will be confined, as far as possible, to checking and correcting calibration. If delivery is not to suffer, pre-production testing cannot be a proving ground for new techniques and untried materials and this is particularly true if the manufacturing programme has lagged a little and reduced the time available for test.

Any development engineer worth his salt will be reluctant to pass-off a unit until all its characteristics are thoroughly understood and production repeatability can be achieved; yet time absorbed in, say, experimenting with seals or obtaining stability by empirical experiment immediately before delivery can never really be justified.

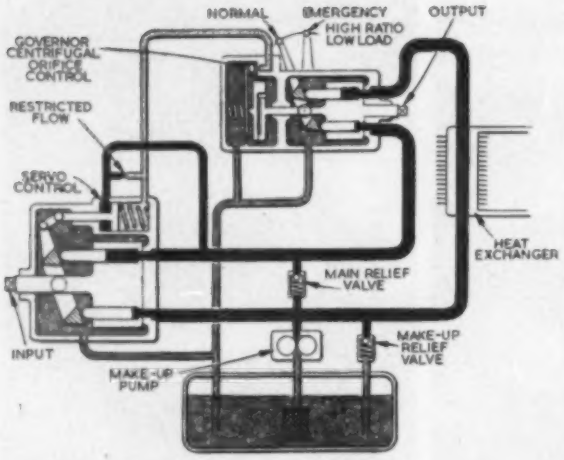
The boundaries of performance are continually being further extended and the industry has an insatiable demand for new methods, new materials, and a continued extension of its knowledge. But the time and the place to acquire this wisdom is not on the test-house floor when the first unit is complete and others are passing through the shops; as many as possible of the unknowns must be sorted out before the designer puts pencil to paper. There will always be a need for intelligent and qualified development engineers to diagnose and correct unexpected test-faults, but it seems quite wrong when the unit is complete to divert precious time and effort in an attempt to compensate for the shortcomings of design knowledge.

It is self-evident that, if equipment with a wide environmental range is to be offered, the designers must be able to seek essential information in sources other than those of past experience. Throughout the component industry there is a variety of opinion about the necessity or extent to which a firm should devote money and manpower to provide such a facility. Lucas Gas Turbine Equipment have few doubts about the value of such pre-design investigation; within the organization is an applied-research group with a staff of about 15, whose responsibility it is to obtain a thorough understanding of small mechanisms. "The idea," say Lucas, "is to reduce the complexity of the engineering that goes into our civil equipment, to keep down design and manufacturing costs and to make use of production along commercial lines to keep our facilities hard at work." Some really valuable investigation has been done by this group, who have become adept at obtaining results with quite simple equipment; some of their work is reviewed in the latter half of this article.

The basis of all the firm's current activities is the multi-piston variable-displacement pump designed by Ifield and taken up by Lucas in 1940, when the Gas Turbine Equipment company was formed. The high-pressure Lucas pump makes possible fine atomization of the fuel and is controlled by a variable-angle swash-plate through a simple servo mechanism. The firm produce all the units of the engine fuel system (such as throttle valves, pressurizing valves, flow distributors, burners, shut-off cocks and so on) and are now making composite flow-controls in which several individual functions are combined in a compact unit. Lucas fuel pumps have been used on the majority of British engines and are also built under licence in the Argentine, U.S.A., France, Sweden, Switzerland and by overseas branches of the Lucas organization in Canada and Australia. Between 80,000 and 90,000 pumps are in service.

The other side of the company's activities began with the establishment in Burnley of a laboratory for combustion research. Thanks to this, Lucas have become firmly established in the research field and they continue to contribute original and valuable development work on gas turbine combustion chambers in addition to applied development for most British engine manufacturers and some outside Britain. Extensive research into the fabrication of sheet metal for use at high temperatures has enabled Lucas to fill some of the void that exists on detailed information on sheet material.

The main production centre for Lucas fuel system equipment is the factory at Broad Green, Liverpool, where 2,300 people—a surprisingly large number of them specially trained for their task—are employed. Amid the alarums of recession and dwindling



Illustrated diagrammatically is the 25 h.p. Lucas-Rotax constant-speed alternator drive. For paralleling synchronous alternators a D.C. signal is injected into the servo system. This design has twin outputs.

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business in the aero-engine industry, Lucas remain busy, although much of their work admittedly is in the repair of fuel system equipment built during the past few years. Beyond 18 months, Lucas say, the future appears uncertain, but they hasten to point out that their future has *never* been clear farther ahead than that.

The Liverpool factory is an object lesson in the application of specially trained labour to the manufacture of precision components. Pistons for the fuel pumps, for example, must be round and parallel to a tolerance of 0.00003in and finished to 0.75 micro inches, and the spherical-surface cam-plate (controlling piston displacement) lapped to be truly spherical to within five light bands when checked against a planar-convex glass prism; these processes are performed and checked by trained operators—very frequently women. The over-riding impression to be gained at this factory (fuel system component production is also undertaken by the Lucas parent factory at Shaftmoor Lane, Birmingham) is the intensity with which precision manufacture can be undertaken.

It is upon this background of knowledge and production competence that the company are basing their hopes for the future. They are justifiably confident of their ability to retain their position as the major suppliers of fuel-system and combustion equipment for British gas turbines and they are determined to pursue a policy of competitive pricing as a contribution to lower engine costs. They share the concern of aero-engine manufacturers that British gas turbines are as yet offered abroad at prices little less than their American counterparts. Much of the technical development that is being pursued by Lucas must remain shrouded by the veil of commercial security, but something of the trend of development can be discerned from the discussion of the research facilities which follows.

Fuel Systems. Although a gas turbine fuel system can ultimately be proven only in flight, considerable data analysis and the lessons of past experience have made it possible to apply known data—perhaps obtained from a ground run of an engine on a test-bed—to an analogue computer and to simulate the system performance under various operating conditions. This has proved to be an inexpensive way, judged by results, of eliminating inherently unsound designs and of providing performance engineers with a rapid method of testing new ideas without the need for building hardware. A sea-level engine test house remote from the factories is equipped for recording data on six channels from an engine installed in a test cell and, to reduce the time involved in processing data, information is recorded on an automatic plotting board. Cross-wires displacing the recording pen are synchro-driven from amplified data passed from many points on the engine through the six channels.

Providing the non-linearities of an ideal fuel flow with the parameters of r.p.m. and altitude is one of the difficult problems that the fuel-system designer has to meet. In this test laboratory Lucas have devised a method of using the automatic plotting facility more or less in reverse. A series of theoretical fuel-system performance curves, cut from black card, are laid over the axes of a plot of standard scale, sensed by the eye of a photocell and fed into the engine as metered fuel to a pre-determined pattern. A transient function of engine performance can then be directly scheduled from a pre-determined fuel flow and the mechanical design of the fuel system adjusted to provide the best approximation to the ideal curve.

Hydraulic Drives. Swashplate-type piston pumps used for pumping fuel can readily be adapted to operate as hydraulic pumps. Lucas have achieved some success with such conversions, and have secured an important order for an aircraft hydraulic pump based on their well-tried fuel pump in the face of strong competition from established manufacturers of hydraulic equipment.

In view of the association of Rotax Ltd., with Lucas (G.T.E.), it was perhaps only to be expected that the two firms should collaborate in the design of a hydraulic constant-speed alternator drive, particularly as there is a closely contested—if limited—market for such units on two new British airliners.

The Lucas-Rotax drive is a 25 h.p. unit that maintains output r.p.m. constant at 8,000± one per cent within an input speed range of 1,700 to 6,000 r.p.m. It consists essentially of two parts: a hydraulic pump and a hydraulic motor. There is no mechanical interconnection and the components can be separated if necessary; the hydraulic motor speed is held constant by varying the angle of the cam-plate in the hydraulic pump. The particular unit developed by Lucas is arranged to drive both a three-phase generator-alternator supplying 5kVA, 400 c/s A.C. at 208 volts and 45kW D.C. at 28 volts, and, for radar purposes, a single-phase, 2,400 c/s 2kVA alternator supplying A.C. at 115 volts. The latter machine is driven at a constant 5,143 r.p.m., through gearing.

The seven-cylinder cam-plate pump is capable of delivering up to 77 gal/hr per 1,000 r.p.m. at full stroke, and is designed to run up to 6,000 r.p.m. At full load, continuously transmitting 25 h.p., the pump delivery is pressurized to 2,500 lb/sq in. Return oil at 100 lb/sq in is passed through a fuel-cooled heat exchanger. Standard rating is 25 h.p. and allowance is made for transient overloads up to 50 h.p., but a continuous rating of 33 h.p. may be adopted on a basis of 50 per cent transient overload. Under conditions of abnormally low input drive power (such as occur with windmilling engines) an emergency output of 8 h.p. is available, and in this condition the cam-plate of the hydraulic motor can be altered to maintain 8,000 r.p.m. at the output.

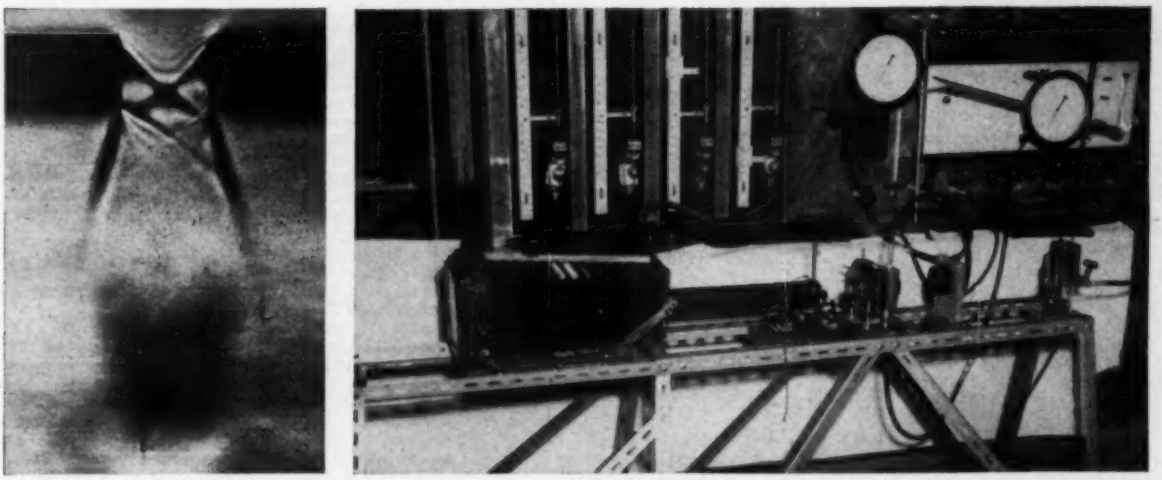
The manner in which the constant speed is achieved is illustrated in the diagram on this page. A centrifugal governor driven by the hydraulic motor actuates a valve orifice which controls the leakage of oil from one side of the pump servo-piston chamber, so adjusting the cam-plate angle in the pump. At constant alternator load a variation in input speed will cause a variation in the flow of oil to the hydraulic motor, and the resultant speed increase will be adjusted through the governor and servo system until the flow again reaches its nominal value. At constant input speed but varying load the flow will be maintained at the nominal value but the pressure will vary with load, since as the speed of the hydraulic motor falls the stroke of the pump will be adjusted through the servo system to increase the system pressure to meet the higher torque requirement. Lucas claim that the response and stability of the servo is well within the limits possible with a mechanical system possessing unavoidable mass and inertia.

During engine starting, provision is made in the hydraulic drive to relieve the starting torque condition by means of a solenoid-operated valve which sufficiently reduces the working pressure of the drive to make the alternators inoperative. For obtaining satisfactory paralleling of synchronous alternators, provision is made for injecting into the servo system an electrical signal proportional to the real power component of a given alternator load. The signal, proportional to kW load, is picked up from the A.C. control panel, rectified and fed as a D.C. component into a solenoid within the servo valve. The servo can hence be biased so as to equalize the kW loads of any two or more hydraulic drives, the "real power" D.C. signals being balanced against each other to give correct kW division under every load condition.

Applied Research. A Lucas precept is that where there is a laboratory there should be a workshop; research, they say, should keep its feet on the ground. The efforts of their applied research section are thus directed towards improved fuel-system design and the end-product, so to speak, of the department's work is the preparation of design standards for the drawing office. A volume of design standards is, of course, usual in most design departments, but it is not common practice for these to be kept really up to date on improved materials and new techniques.

Lucas research has been aimed at making available technological knowledge with which the designer can meet extending environmental requirements of fuel systems for both manned aircraft and missiles. The target conditions which were laid down were fuel at 2,000 lb/sq in pressure and a temperature range of −30deg C to +250deg C and air at 250 lb/sq in pressure and up to 500deg C temperature. The work covers the investigation of the behaviour of gases and liquid passing through orifices and valves, a study of metal elasticity and investigations into the behaviour of seals.

The firm estimated that it would be worth something like £100,000 a year to them to have a complete understanding of the mechanism of sealing, and the laboratory consequently undertook a programme of research into the chemistry of elastomers and the control of seal nip. To meet the conditions under which fuel-system seals must work they found it necessary to depart from the British Standard specification and, in order to avoid very fine face and diametrical tolerances to control the diameter of the seal to 0.001in. An interesting result was obtained in the case of shaft seals by using a ring of ten times representative size; it was found



Pattern of sonic airflow through a 0.005in diameter orifice. This photograph was obtained with the Schlieren apparatus seen on the right. While Lucas test equipment is the best that can be obtained, this particular rig, constructed by the applied research laboratory from improvised equipment, cost only a few pounds. It typifies the ingenuity of the research engineer.

that the best results were obtained when the interference between shaft and seal was kept to a minimum.

Because many seal-manufacturing firms are quite small, it has become encumbent on the component industry to participate extensively in the development of seals for special purposes. Lucas are not by any means alone in this, but they have probably carried their research further than most, both with metal and filled sealing rings and back-up rings and with hesprene, nitrile, silicone, fluorine, fluo-silicone and urethane elastomers.

With steadily increasing temperatures, new materials to replace STA.1 (manganese/chrome alloy) steel springs have been found necessary. Tests to determine the upper limiting settlement-temperature have been carried out with heat-treatable alloys (for example, Nimonic 90) and sub-zero-worked stainless steels. Useful work has also been done on thin-wall metal bellows, but bought-out components are widely used. Lucas employ seamless deep-drawn tube in order to dispense with the necessity for welded seams and have devoted much time to the development of heat-treatment techniques to avoid scale and oxide penetration on the bellows. A promising venture is the use of high-frequency brazing in vacuum; this provides a good high-temperature joint and eliminates a separate sealing operation if the bellows is to be evacuated. The information has been compiled as an engineering design standard, and stress formulæ enable a designer to select a suitable material, thickness and convolution and to calculate accurately the level of stress. Other studies have been made into the ways of determining the effective area of rubber diaphragms, and the development of Ni-span C capsules and control valves.

Some of the most intesting work of the laboratory has been concerned with fluid flow through sharp-edged and chamfered orifices, particularly those of very small diameter. Starting with the simplest form of orifice—a plain round hole—it was found that after a certain critical length flow was highly dependent upon the ratio of the pressure-drop to the downstream pressure (the cavitation number). It was found that for certain lengths of orifice there could be two different flow-rates for the same pressure-drop and back pressure. Work on chamfers showed that the optimum chamfer to obtain consistency in discharge coefficient also reduced cavitation to a minimum.

As illustrated on this page, Schlieren photography has been used in a programme of work on sonic airflow through orifices. The object of the investigation has been to determine the best geometry for the orifice in order to give a constant mass-flow condition at the lowest possible pressure ratio.

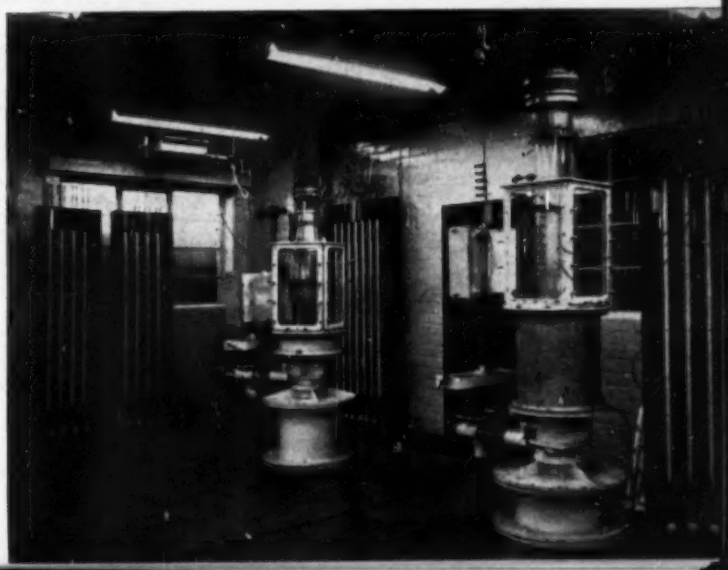
The thoroughness with which Lucas undertook their applied research is typified by their enlisting the co-operation of the Universities of Birmingham, Manchester, Cambridge and London, as much of the applied research performed by Lucas (G.T.E.) has shown the opportunity for more basic and extended studies.

Combustion-chamber Research. The sheet-metal side of the Gas Turbine Equipment company's work—embracing combustion chambers, ramjets, nozzles, titanium shrouds and so on—has been centred on Burnley since 1941, and in production shops and research laboratories the company's service to industry is in both manufacture and ideas. Lucas claim that their materials engineering laboratory has extended the use of sheet metal in precision engineering. It can be rigidly controlled and held to close tolerances during manufacture, and the strength, fatigue and fabrication properties of the metals used are well understood. The company's work on sheet materials is in the realm of applied research, the laboratory obtaining new materials from manufacturers as soon as they become available. Current investigation is concerned with titanium and the higher grades of Nimonic sheet, and particularly with welding techniques for Nimonic 80.

The heart of the combustion-chamber development process lies in the analysis of new designs by flow-rig testing, and some exciting work is under way at Burnley. It is now well known that the company make extensive use of water-flow rigs for a first analysis of new combustion chambers and modifications to existing designs. A full size Perspex model of the chamber (or a part-section in the case of a large annular chamber) is mounted vertically and the flow pattern studied by means of adjustable bar lighting and air bubbles in the water. A very rapid first analysis of a new feature is possible and the facility is particularly valuable for studying vortex formation in the combustion and cooling air flows.

A promising design—as proved by the water-flow rig—can then be translated into metal and tested on the air and fuel rigs in the test cells. The many test stations are fed by air delivered from massive reciprocating compressors. A wide range of readings can be made on any rig, the more important being pressure-drop across the chamber and chamber exit temperatures (T_3) and pressures. The latter are recorded by an indexing device which records, via sensing probes, conditions across the complete cross-sectional area of the discharge. This is a vital aspect of combustion research, since it is important to match the T_3 temperature gradient to the stress gradient of the nozzle and turbine blades.

A proportion of the work at Lucas is devoted to research on



On test at Burnley are Perspex combustion chambers in their rigs. This part of the research laboratory can be blocked-out and the rigs individually lit by bar lighting to improve the definition of the water-bubble trace through the transparent chamber.

Typical flow pattern obtained on a fluid-flow rig. Note the formation of vortices on the chamber walls and the swirl induced in the mixing zone.

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combustion fundamentals, the Utopian ideal being to find the configuration of combustion chamber that permits the widest band of operating air/fuel ratios for flame stability and the maximum attainable rates of heat release for a minimum loss of total pressure. This is, of course, ultra-long-term research, but each step toward the ultimate can be applied separately. Typical of the progress made to date is an experimental reduction in the combustion process time from the normal 8 millisec, with a consequent shortening of flame length and hence, also, of the length of the combustion chamber. The trend of development is broadly towards higher chamber pressures—200 to 250 lb/sq in are envisaged—and temperatures raised to the maximum within the possibilities of current metallurgical knowledge. A chamber outlet temperature of 1,500deg K, for example, may be associated with an air/fuel ratio as low as 40 : 1, with consequently less air available for mixing and skin-cooling (normal overall air/fuel ratios are of the order of 5 : 1).

Shorter-term development—largely associated with combustion chambers for particular engines—is at present much concerned with the sensitivity of combustion chamber performance to air velocity distribution at the compressor discharge, particularly since refinements in engine length and weight demand that the space between compressor and combustion chamber be kept to the minimum. Distribution of gas temperature at the combustion chamber discharge is another current problem; the trend is towards higher temperatures than hitherto and applied project research is being directed towards revised air distribution and mixing and to increased heat release.

Although Joseph Lucas (G.T.E.) is large in comparison with many of the ancillary firms which support the aircraft and aero-engine industries, it is not mere size that makes the firm impressive. Nor is it the fine quality of its precision work, the skill with which sheet metal is manipulated, or the quantity of its output, important as these assets may be. Rather, the lessons that Lucas have to impart are that sound, old-fashioned commercial principles can be applied successfully to an industry faced, as never before, with competition for survival, and that applied research is too valuable a tool ever to be hastily laid aside. A. T. P.

DISCUSSING DE-ICING (continued from page 885)

coat thinnest, but experience had shown that the best results were obtained when the base coat was about two-and-a-half times the thickness of the top coat. Under laboratory conditions a top coat only 0.005in thick was possible, but under manufacturing conditions a thickness of 0.012in to 0.015in had to be accepted, though development would doubtless reduce this depth. The "sandwich" structure was therefore about 0.050in thick, with the electrical elements about one-quarter of the thickness from the top.

Gaps between the elements had, of course, to be provided and these created cool spots on the protected surface. Theoretical and practical work had shown that little improvement in ice-shedding occurred by reducing the gap to less than about twice the top coat thickness. Thinner top coats would therefore mean narrower gaps and better shedding.

The speaker explained that the layout of the circuits had to be complex because power had to be applied in direct proportion to the icing danger at any given area of the protected surface. He then discussed the merits of *in situ* applications and pre-fabrication on a mould, the materials of construction, heater-mat design, and the protection of mats from damage by stones, heavy hail and other causes.

Concluding his talk, Dr. Roper listed some of the problems still facing designers of electrical de-icing systems and said that he was satisfied that wherever an aircraft icing problem existed a mat would be found to meet it.

The last paper to be presented was by **Mr. E. O. Robertson,** of Canadian Applied Research, Ltd., and was read in his absence by Mr. D. L. A. Hand, of Napier. It dealt with the *Development of Ice Protection Control Systems*, and opened by stating the basic requirements of an ice protection system.

It had to be effective, simple and reliable, economical to operate and maintain, light in weight, and inexpensive to install initially. The control system had to initiate icing protection only as soon as it become necessary, and give an indication to the crew that this had been done; control the protection system through an icing encounter to obtain the maximum possible benefits from the system in the particular conditions encountered; warn the crew of any failure or irregularity in the system to permit alternative action to be taken at the time (and corrective maintenance action at the first suitable opportunity) and, finally, switch off the protection system as soon as possible after leaving the icing condition and indicate to the air crew that this had been done.

After detailing the processes involved, the paper described and illustrated equipment which had been developed in Canada and put into use. Its weight, Mr. Robertson said, might lie between 5 lb and 15 lb according to the size and power density of the shedding areas.

We are informed that copies of the papers, with reports of the discussions, will shortly be available from the Flight Development Establishment, D. Napier and Son, Ltd., Luton Airport, Beds.

HOBSON DEVELOPMENTS ON DISPLAY

ON Wednesday of last week H. M. Hobson, Ltd., demonstrated at their works at Wolverhampton the Microjet pressure ratio control that they are now developing under licence from the Solar Aircraft Company of San Diego. Among those present was Mr. W. E. P. Johnson, well remembered for his early gas turbine work with Power Jets, Ltd.; he is now European manager to Solar.

Applications of the Microjet unit (which was fully described in *Flight*, December 2, 1955) include the fixed-proportion mixing of fluids at varying flow rates, achieved by sensing the ratio of pressure differences produced by orifices in the flow-path of each liquid. When used as a ratio meter of the gas pressures in two probes, the device can indicate the position of oblique and normal shocks in supersonic intakes; the operating conditions of air compressors and gas turbines and the matching of gas-turbine exhaust nozzles. It can also operate as a reheat burner "on-off" senser. In most cases, the output movement of the Microjet is employed to operate a switch or a servo; accuracy of control depends upon reducing the forces on the central orifice-controlling needle to a minimum. The system is applicable to pneumatic, hydraulic or, indeed, electric operation, and an elaboration of the Microjet principle can be adopted as a Machmeter for supersonic aircraft or missiles.

Production of the Microjet, which is made from stainless steel, has led Hobson to make use of the technique of high-temperature brazing in a hydrogen atmosphere. This has also been used experimentally in the production of built-up hydraulic servo valve guides with square ports. Among recent new equipment installed at Wolverhampton is an Elliott analogue computer to assist in the theoretical analysis of new projects; an associated advantage is the rapidity with which changes in valve and guide design—previously requiring many operations in the manufacture of experimental parts and the basis of much Hobson work—can be investigated.

In view of the intense competition for the supply of constant speed alternator drives, a new development from Hobsons is particularly noteworthy. Superseding the hydro-mechanical drive announced earlier, the new design is of 40kVA capacity and intended for civil markets. It embodies two mechanical differential gearboxes and a hydro-mechanical coupling unit. It is completely self-contained and promises to show really substantial savings in weight over other designs of equivalent capacity.

An appraisal of the company's activities, "Control Systems Outlook," appeared in *Flight* of November 15, 1957.

SMITHS DOVE COMPLETES TOUR

THE first of a series of sales and demonstration tours by the D.H. Dove operated by Smiths Aircraft Instruments, Ltd., and fitted with the S.E.P.2 flight control system was recently completed. The 5,000-mile flight took the aircraft, under the command of Mr. R. A. Palmer, Smiths chief pilot, to France, Spain, Portugal and Italy; and of the 50 hours' flying, some 15 were spent in demonstrations. At Lisbon particularly, the S.E.P.2 achieved successful automatic approaches in extremely severe frontal weather, with gale-force winds and a ceiling of 300ft. In addition to the S.E.P.2 and flight director instruments, the Dove carries various Smiths cockpit and navigation instruments.

FAIREY

flies the first vertical take-off Airliner

Adding achievement to achievement,
Fairey Aviation have now built—and flown—
potentially the most important transport aeroplane
in the world, the Fairey Rotodyne.
Carrying 48 passengers or 4½ tons
of freight it takes off vertically as a helicopter
and having gained height flies forward
as a normal twin-engined airliner.
It is the most adaptable rotary-wing
aircraft in the world and the first to offer
operating economy directly comparable to that
of fixed wing aircraft over ranges of up to 400 miles.
The arrangement within the Rotodyne's
capacious fuselage can readily be adapted to suit
civil or military applications.
Powered by two Napier Eland
propeller-turbines with Fairey Pressure-Jets at the
rotor-tips for take-off and landing.

48 passengers
185 m.p.h. cruising speed
400 miles maximum range

FAIREY
Rotodyne

THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX
ENGLAND · AUSTRALIA · CANADA

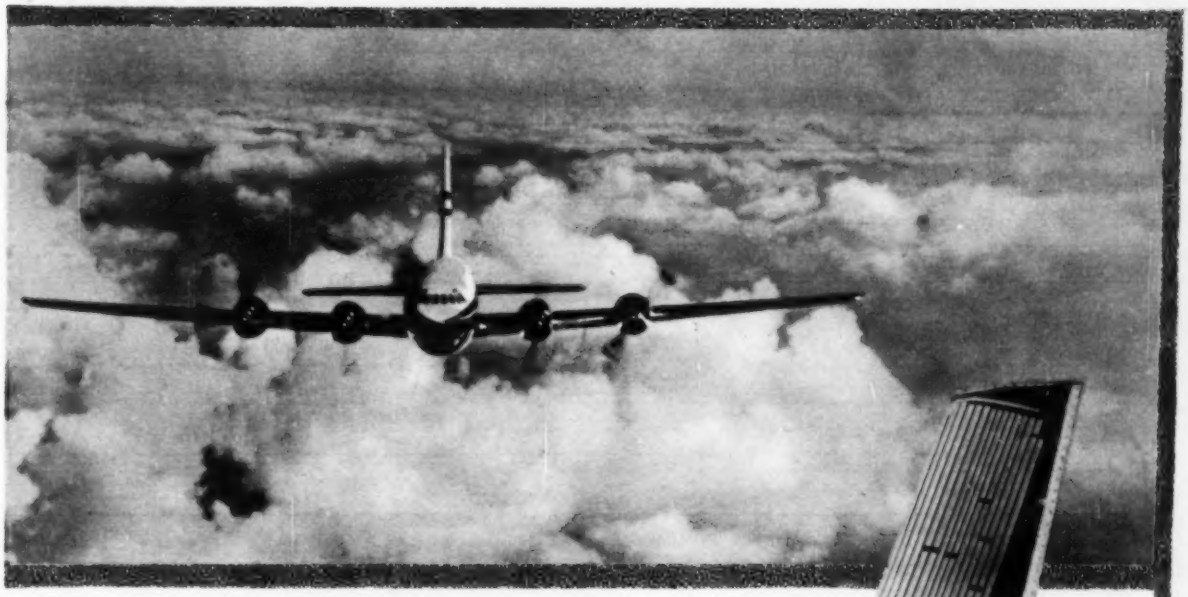
NEW POWER

The outstanding capabilities of the Napier Double Scorpion aircraft rocket engine were demonstrated by the Canberra Mk. 2, which established the height record of 70,310 ft. on August 28th, 1957 in the course of routine development tests. The Scorpion rocket engine is primarily designed to provide extra power at high altitudes where the thrust of the ordinary jet engine begins to fall off, and so enable jet propelled interceptor aircraft to operate at the heights essential for modern defence. The Scorpion is a light, economical source of controlled power, simple to install, calling for virtually no maintenance. Standard gas turbine fuel and H.T.P. are used as the propellents. The engine is not, therefore, affected by the low density of air at high altitudes. In fact, its efficiency actually rises with increased height. The Scorpion has been designed and developed at Napier's Flight Development Establishment at Luton, Bedfordshire.

NAPIER SCORPION

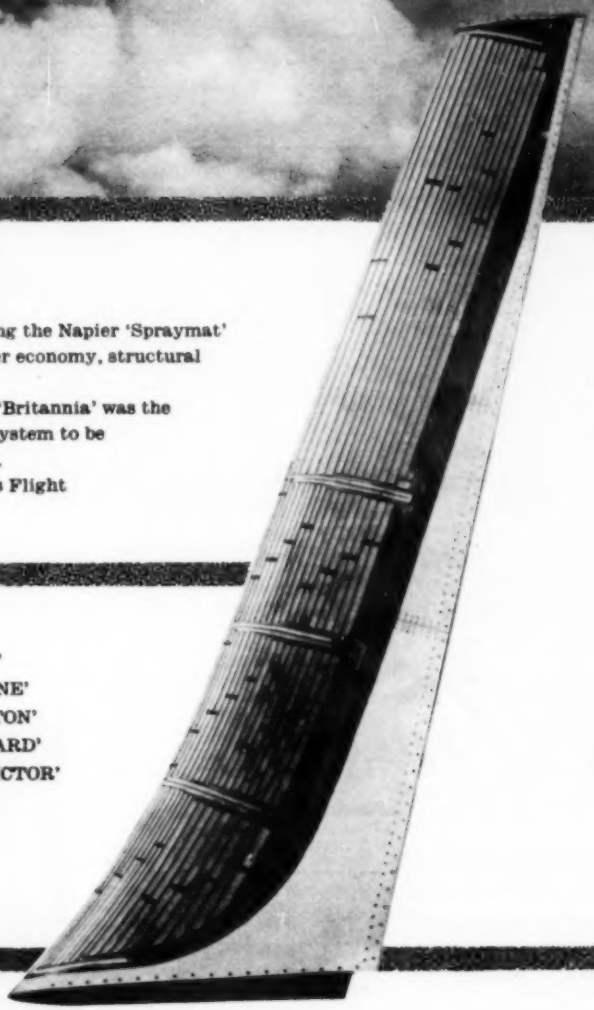
AIRCRAFT ROCKET ENGINE

D. NAPIER & SON LIMITED • ACTON • LONDON • W.3



NEW PHILOSOPHY

More aircraft constructors than ever are now specifying the Napier 'Spraymat' ice protection system as the best combination of power economy, structural simplicity, light weight and proven performance.
The 'Spraymat' system on the tail unit of the Bristol 'Britannia' was the first example of an airframe electrical ice protection system to be approved by A.R.B. and C.A.A. for civil airline service.
Spraymat has been designed and developed at Napier's Flight Development Establishment, Luton, Bedfordshire.



Spraymat has also been chosen for:—

Canadair 'ARGUS'	Fairey 'GANNET'
Blackburn 'BEVERLEY'	Fairey 'ROTODYNE'
Sud Aviation 'CARAVELLE'	Avro 'SHACKLETON'
de Havilland 'COMET'	Vickers 'VANGUARD'
Canadair 540	Handley Page 'VICTOR'
Fokker 'FRIENDSHIP'	Avro 'VULCAN'
Armstrong Whitworth 'FREIGHTLINER'	

and numerous other projects both in Europe and the North American Continent.

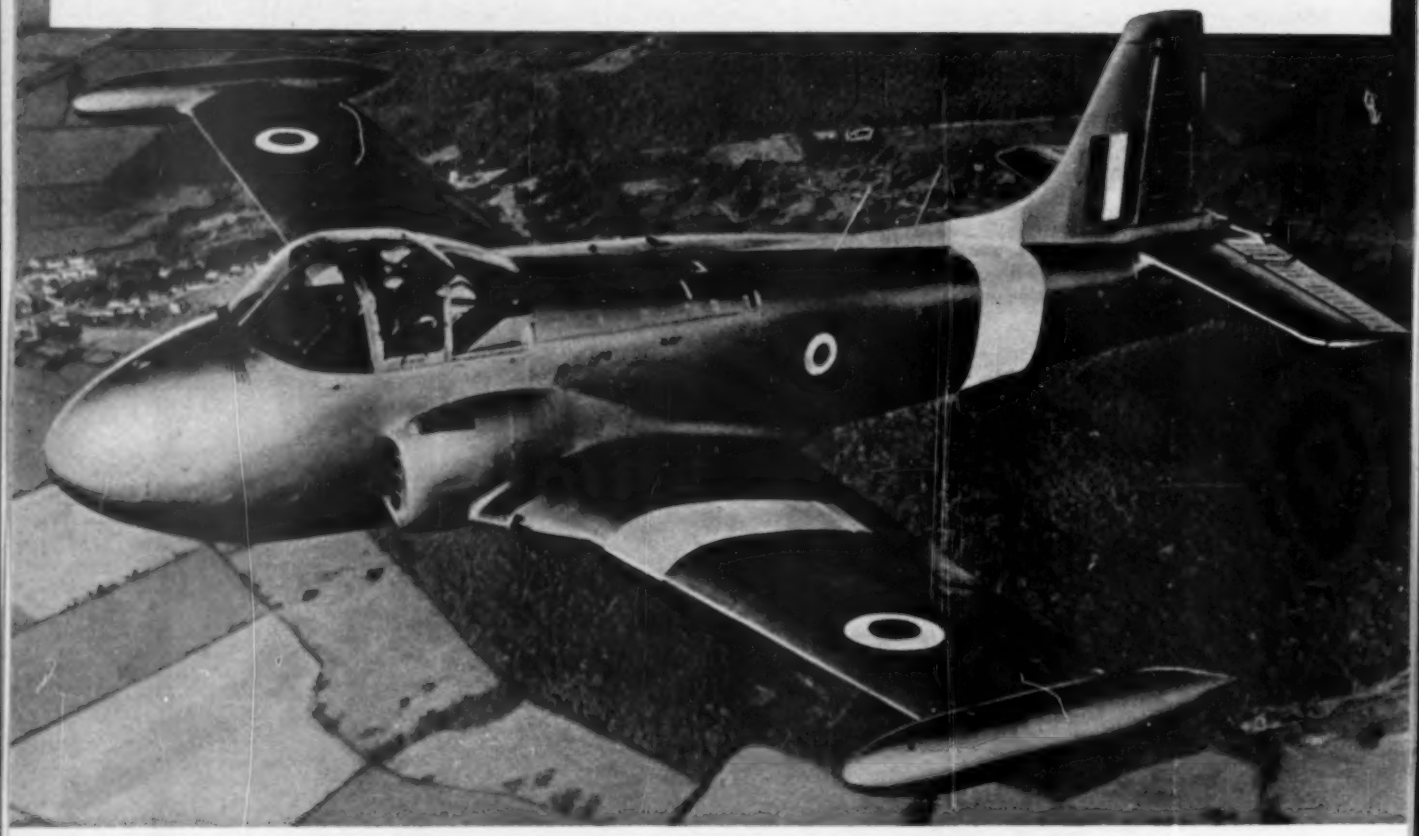
NAPIER Spraymat TRADE MARK

SURFACE HEATING SYSTEM

A Member of The ENGLISH ELECTRIC AVIATION GROUP

CBC 543

In service with the Royal Air Force



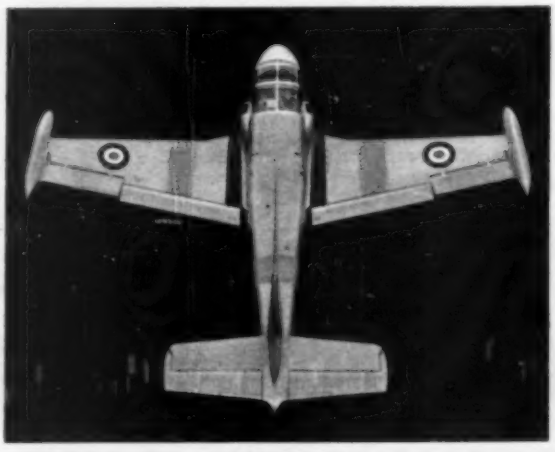
Two years service with the Royal Air Force has established the Jet Provost ab initio/basic trainer as the best aircraft for its purpose, and the Mk3 is now in production for the re-equipment of Flying Training Command.

Jet Provost

Powered by one Armstrong Siddeley Viper Turbo Jet.

Improvements over the Mk1 include a redesigned undercarriage and windshield, a later mark Viper engine of increased power, increased fuel capacity and the installation of ejection seats.

The Jet Provost can be supplied to overseas air forces with or without ejection seats and can also be equipped with armament—machine guns, bombs and rockets—for use as a weapons trainer or as a tactical weapon.



HUNTING AIRCRAFT LIMITED

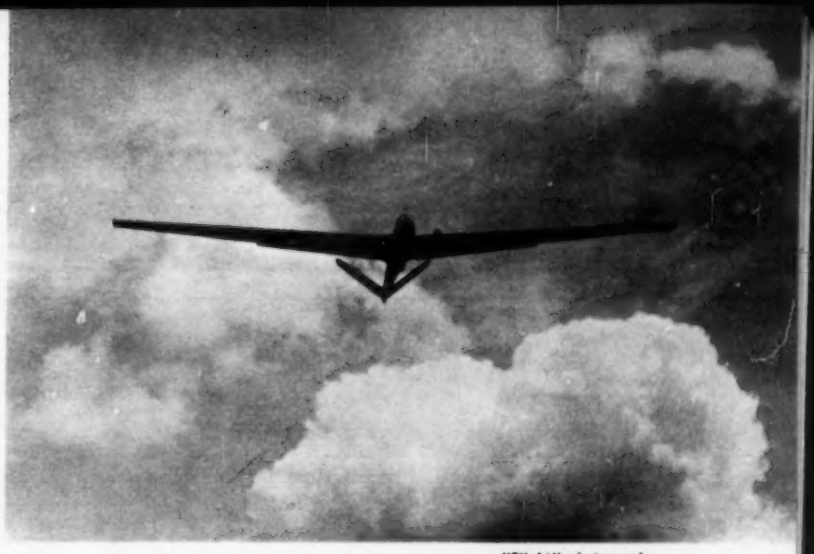
A Hunting Group Company.

LUTON, BEDFORDSHIRE, ENGLAND and at 1450, O'CONNOR DRIVE, TORONTO, CANADA

AP349

"FLIGHT" STORY BY KENNETH OWEN

World Gliding Championships



"Flight" photograph

2—THE FIRST WEEK OF CONTEST FLYING

Leszno Airfield, Poland

THE opening ceremony at Leszno on Sunday, June 15, was followed that afternoon by a superb display of gliding flight. Outstanding items in a high-quality programme included individual aerobatics in a Jaskolka L by J. Popiel; formation and follow-my-leader aerobatics in three Jastrzabs flown by S. Ackerman, Z. Szubra and J. Lacki; and a four-glider aerotow by a Yak-12. (Picture page 883.)

From the far side of the airfield an SM.1 helicopter buzzed over, and your correspondent steeled himself for yet another selection of the customary helicopter gyrations. This was not for Leszno, however: down from the helicopter snaked a long rope, rapidly to be attached to a Jaskolka glider. With a purposeful lunge forward the unconventional aerotow began.

That was not all. After towing the Jaskolka up to a reasonable height the helicopter slowed down and finally hovered, dangling the sailplane underneath like a fish on a line. The pilot of the Jaskolka, J. Adamek, extricated himself from this unenviable position simply by pulling the release-knob. And he went through a neatly polished routine before landing safely. Incredible.

To complete the programme a trio of Junak 3 light aircraft performed competently in formation, as did an individual and three formations of Mig-15s. The Mig formations were of three, four and five aircraft respectively. Star turn was the quartet, with two machines all-white and two all-red, but none of the Mig groups exactly sparkled with imagination. A final low pass by a Mig-17b completed the programme.

Monday, June 16, was the first contest day, and most crews had already rigged their gliders by the time the pilots and team captains assembled for the 9.30 briefing, carried out in Polish, French and English. A late arrival that morning was the two-seater HKS. 1, which R. Kuntz of West Germany was to fly in place of Hanna Reitsch (Zugvogel).

The task for the day, sports director Tadeusz Rejniak announced, was a 230-kilometre out-and-return race south-southwest to the airfield at Jelenia Gora. As the crackle of unfolding maps cut across the buzz of discussion among the pilots, launching details were announced. Release height over Leszno would be 700 metres, and the starting line and turning point must be crossed at not more than 1,000 metres.

As for the weather, it was clear that today's conditions would be more difficult than in the later half of the practice week, when fast speeds around 100, 200 and 300 km triangles had been set up by many pilots. The clear blue sky and warm sun indicated the anticyclonic area in which Leszno was situated, and what instability there was would not extend to any great height.

At 10.50 Hans Resch of Austria in his Musger Mg. 23 was signalled off behind one of the efficient Junak 2 tugs, and the seventh World Gliding Championships had begun. Take-offs went smoothly and quickly, although Deane-Drummond in the Olympia 419 abandoned his first tow during the ground run when his wing hit the grass (there was a marked crosswind over the take-off strip). After the open class had been despatched, the standard-class machines followed. By 11.30 all were airborne, and the green Junaks scuttled back to their side of the airfield.

Soon the sailplanes were leaving the dry thermals in which they had circled, and were heading straight across the starting line to begin the race. Nick Goodhart in his Skylark 3 landed back for a second launch after he believed himself to have crossed the line too high, and made a second start at 12.30, eight minutes after the two lean Meteors had set out in purposeful formation.

At 2.20 came the news that Mestan (Czechoslovakia), Persson (Sweden) and Maxey (U.S.A.) had been reported over the turning point at Jelenia Gora. And, indeed, it was Mestan in the blue Démant numbered 36, who scooped in first across the finishing line just before four o'clock. A total of 21 aircraft completed the course, of which five were standard-class entries. The 21 included all four Polish machines; both of Britain's open-class gliders; three Czechs; and Maxey (Zugvogel 3) and Bikle (Bréguet 901), U.S.A.

It seemed that this was not the Meteors' day, for only one of them completed the course, and in a relatively slow time. It seemed also that the Zugvogel was a useful aircraft in this kind of light-thermal condition: three of this type had been successful. Both Deane-Drummond and Nick Goodhart reported extremely difficult soaring all the way—Goodhart at one stage was as low as 300ft above the ground and had just about given up—and the two British standard-class pilots, Wills and Tony Goodhart, both landed near the turning point, as did a lot of other people.

Fastest time over the out-and-return course was set up by Haase of West Germany flying the HKS. 3, who thus took the lead in the open class with 1,000 points. His average speed was 55.4 km/hr. In the standard class the leaders were Witek and Wojnar, both of Poland and both flying Mucha Standarts. A remarkable coincidence was the fact that Deane-Drummond and Nick Goodhart, flying different types of aircraft in difficult conditions (involving circling for periods up to 45 minutes without gaining any distance forward along track) logged identical speeds (46.9 km/hr).

The leading positions at the end of the first day were as follows:—

Open Class: (1) Haase, West Germany, 1,000 pts; (2) Weiss, France, 973; (3) Mestan, Czechoslovakia, 949; (4) Barbere, France, 942; (5) Gorzelak, Poland 930; (6) Makula Poland, 929; (7) Maxey, U.S.A., 927; (8) Laur, West Germany, 900; (9) Deane-Drummond and N. Goodhart, Gt. Britain, 856; (11) Kumpost, Czechoslovakia, 854; (12) Molander, Sweden, 846.

Standard Class: (1) Witek, Poland, 1,000; (2) Wojnar, Poland, 981; (3) Persson, Sweden, 979; (4) Huth, West Germany, 972; (5) Tandefelt, Finland, 845.

The task on **Tuesday, June 17** was a short (100 km) triangular race with turning points at Rawicz and Gostyn. A pessimistic met. forecast was proved wrong soon after Kumpost in the

"Flight" photograph

Official informality (l. to r.): Jerzy Swiatek, contest director; A. ("Pirat") Gehriger, president of F.A.I. Gliding Commission; T. Rejniak, Polish Aero Club secretary and "directeur sportif" of the championships; Wojejkow, Russian team captain; J. Sandauer, president of judges' committee.

(Right) Familiar hat identifies Philip Wills, standard-class (15-metre sailplanes) competitor in his Skylark 2.

"Nick Goodhart was seen to be balanced in an unenviable position on a pedestal on the far side of the airfield . . . with the aspect ratio of his Skylark 3 sadly reduced by the omission of the outer wings."

"Flight" photograph

World Gliding Championships . . .

Czechoslovak Spartak took off on the first tow at 11.30, for there was little delay before the stream of sailplanes across the starting line began.

The day bubbled up nicely, in fact, and there was soon little doubt that most of the pilots would complete the triangle—indeed, a harder task would have been acceptable. At 1.45 p.m. the returning stream began, headed as on the previous day by Mestan in his blue Démant. As some of the pilots were making steady progress with their late lunches, and initial estimates of relative speeds were attempted, Nick Goodhart was seen to be balanced in an unenviable position on a pedestal on the far side of the airfield. With the aspect ratio of his Skylark 3 sadly reduced by the omission of the outer wings, he was making "a typical cross-country flight"—at about 6ft above the ground—for the benefit of the official Polish film unit which was recording all aspects of the championships for posterity. Assistance was being given by technical assistants who supported the tail, and moved it up and down, and by others who pulled ropes attached to each end of the centre-section. It was duly noted by the technically-minded that, while the German HKS sailplanes used wing-warping in place of aileron control, the incredible English used little men with ropes.

Turning from cinefrivolity to the day's serious business, we learned that, in the open class, Haase in the HKS.3 had again notched up 1,000 points for the fastest flight of the day, having averaged 83.4 km/hr. The strong thermal conditions had made it appear to be a Meteor-type day, and indeed, Komac and Saradic had flown the two all-metal Jugoslav beauties into second and fourth places, but Britain was beginning to rise to the top, too, for Deane-Drummond in the sturdy Olympia 419 had gained third place with 76.6 km/hr.

In the standard class Witek was again top, but his compatriot Wojnar had been pushed into third place by Zvonimir Rain of Jugoslavia flying an Ilindenka—perhaps the only standard-class machine to be fitted with an ashtray. Persson of Sweden (Zugvogel) and Philip Wills were placed fourth and fifth, with Silesmo (Zugvogel) and Tony Goodhart (Olympia 415) of the same two respective countries sixth and seventh. After two days' flying the leading positions were:—

Open Class: (1) Haase, West Germany, 2,000 points; (2) Gorzelak, Poland, 1,781; (3) Makula, Poland, 1,772; (4) Mestan, Czechoslovakia, 1,755; (5) Deane-Drummond, Gt. Britain, 1,746. N. Goodhart was 13th with 1,529.

Standard Class: (1) Witek, Poland, 2,000 points; (2) Wojnar, Poland, 1,935; (3) Persson, Sweden, 1,890; (4) Huth, West Germany, 1,643; (5) Rain, Jugoslavia, 1,489. A. Goodhart was eighth with 1,157 and Wills tenth with 1,079.

Wednesday, the third contest day, provided a contrast to the previous day's flying, with an ambitious task in marginal weather. It was to be a goal race to Warsaw, a distance of 315 km. This announcement really did raise the decibels in the briefing room. A trough of low pressure was approaching, said the met. man, and as the day progressed the weather would deteriorate, with the possibility of thunderstorms in the evening. It was expected that it might be quite difficult for pilots to get away from Leszno, but conditions along the route should improve.

Promptly at 11 a.m. launching began, and it became clear that not only was it difficult to get away, it was no easy job simply to remain airborne. Several aircraft were forced to land back, and many postponed their first launches.

By noon Deane-Drummond and Nick Goodhart were on the way, while many others were struggling hard over Leszno town. Both high and medium cloud was coming in; it was hazy, and thunderstorms were clearly heading our way. During the early afternoon we learned that many of the gliders had come down near Gostyn, less than 50 km away. The two British open-class pilots were in touch with their retrieving crews by radio and, in fact, were in visual contact also, for the going was so slow for the 419 and the Skylark that the cars had no difficulty in keeping up with them.

Base-crew members at the main control point for the British team on the airfield, where the radio in Ann Welch's team-captain car was connected to the high aerial erected by radio engineer John Williamson, were able to keep in touch with the two pilots up to a range of about 100 km (this range was improved later by modification of the aerial), after which we had just to sit and wait.

When the results did come in we knew it had been a good day. Although no pilot had been able to reach the goal, Deane-Drummond had landed only 20 miles short—the day's best distance. The Olympia 419 had squeezed the utmost out of the unco-operative air to outfly its more expensive rivals, and its pilot—who at one stage of the flight had been circling as low as 300ft above the ground—had been within sight of the city of Warsaw when forced to land near Blonye.

Other British pilots had also done well, Nick Goodhart achieving 239 km to a point north of Lowicz and, in the standard class, Tony Goodhart making 211 km to Bielawy. In their respective classes these flights were placed fifth and seventh.

Kumpost and Mestan of Czechoslovakia and Kuntz of West Germany were second, third and fourth behind Deane-Drummond in the open class (as nobody reached Warsaw the day's results were measured simply as distance along a set line), with the two Jugoslav Meteor pilots Saradic and Komac level sixth behind Nick Goodhart. The standard-class leaders were Tandefelt of Finland (Ka.6), 251 km; Persson (Sweden); and Horma (Finland).

Deane-Drummond's 1,000 points for the day had made him a close runner-up to Haase on total marks in the open class, while Tony Goodhart was now lying sixth in the standard class. The exact markings were as follows:—

Open Class: (1) Haase, 2,778; (2) Deane-Drummond, 2,746; (3) Mestan, 2,663 (4) Kumpost, 2,568; (5) Laur, West Germany, 2,513; (6) Saradic, 2,441; (7) N. Goodhart, 2,377.

Standard Class: (1) Witek, 2,916; (2) Persson, 2,886; (3) Huth, West Germany, 2,515; (4) Tandefelt, 2,374; (5) Wojnar, 2,062; (6) A. Goodhart, 1,958.

Most crews were out on retrieves when a king-size thunderstorm hit Leszno that evening. Canvas awnings, display panels and the roof of the Motoimport kiosk were blown away from their moorings, and a group of team-members were surprised to see large wooden letters hurtling through the air in front of them, leaving irregular gaps in the spelling (in Polish) of VII WORLD GLIDING CHAMPIONSHIPS on the administration block roof. The tents in which we were living staggered somewhat under the force of the gale, but the interiors stayed dry—unlike the Press office, where the buckets arranged to intercept the water pouring in through the ceiling were themselves tending to float away.

Thursday was declared a rest day. The pilots therefore rested and took no action as superb long-distance conditions developed. A sprightly PZL. 102 Kos (blackbird) two-seater, powered by a 65 h.p. WN.1 flat-four engine, purred in and attracted much interest.

At 10.30 that morning the seventh OSTIV congress was officially opened, the ceremony taking place in the People's Hall of Culture in the town of Leszno. M. Agesilas of the French SFASA spoke on the development of gliding and its importance for aviation and science, and films were shown of the Sierra Wave project and of the 1956 world gliding championships at St. Yan. The OSTIV technical sessions, held in a lecture room at the airfield, were inaugurated that afternoon, when L. A. de Lange, president of the organization, introduced Mr. Beverley Shenstone of B.E.A., who spoke on the present state of sailplane design.

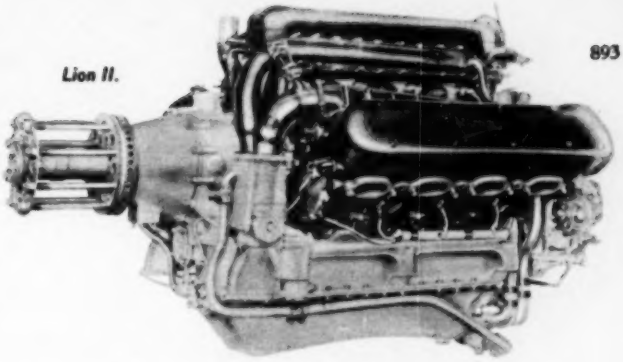
Medium and high-level cloud ahead of an approaching warm front caused flying to be cancelled on the following day, **Friday**, and typically English rain and low cloud had the same effect on Saturday. Visiting aircraft on Friday included a Czech Meta-Sokol four-seater and a specimen of the worthy Zlin 226 Trener. On **Saturday**, a special OSTIV committee examined the various standard-class machines as a preliminary to the award of the OSTIV prize for the type judged to be the best combination of cheapness, simplicity and efficiency. Philip Wills' Skylark 2 was the first to appear on the apron in front of the hangar and to be rigged, examined, and de-rigged. A rival attraction was the showing of the award-winning Polish film *Kanal*.

On **Sunday** flying was resumed with a goal-race to Ostrow Wielkopolski, 95 km to the east. Juhani Horma, the Finnish pilot flying a PIK.3c in the standard class, surprised his open-class brethren by beating them all; in the process he achieved 87.5 km/hr, the day's best speed. Haase again topped the open class, but Deane-Drummond failed to reach the goal by a matter of 10 km, thereby slipping to ninth place in the overall scoring.

Stop Press: Bad weather last **Monday** cancelled flying.

Deane - Drummond's Olympia 419 stood high in the open-class scoring until bad luck in last Sunday's race dropped it to ninth place.

NAPIER
Aero-Engines



Lion II.

Their Characteristics and Applications: A Birthday Album

THE most appropriate tribute that *Flight* can pay the firm of D. Napier and Son, Ltd., in this year of their 150th anniversary, is to review the aero-engines which have perpetuated that company's fame since 1918.

Napier built their first engines for aircraft—to official designs—in 1915; and in 1916 Montague Stanley Napier offered to produce, at his own expense, a wholly Napier unit. This was the famous Lion, designed by A. J. Rowledge, and it appeared in 1918. The Lion was fitted to aircraft which won two Schneider Trophy contests and four Aerial Derbys. It went on to establish speed records, and airline reliability records.

In 1921 Mr. Rowledge left, and ten years later Montague Napier died. By an arrangement between the Air Ministry and de Havilland, Major Frank Halford, working as a consultant, designed the 16-cylinder air-cooled Rapier, and this was followed by the 24-cylinder Dagger. The last of the Halford/Napier engines was the Sabre, best remembered as the powerplant of the Hawker Typhoon and Tempest.

In 1942 the English Electric Company bought all the Napier share capital and acquired control. Nevertheless, Napier have continued to function with their own board of directors, which includes one or more representatives of English Electric.

The first Napier gas turbine was the Naiad, and a contemporary engine of different character was the two-stroke heavy-oil Nomad. Like the Oryx gas generator, these developments were abandoned, but the Eland and Gazelle turboprops are now in production for very important applications.

The fifty-year-old Lion continues growling to this day—as a marine powerplant under the designation Sea Lion.

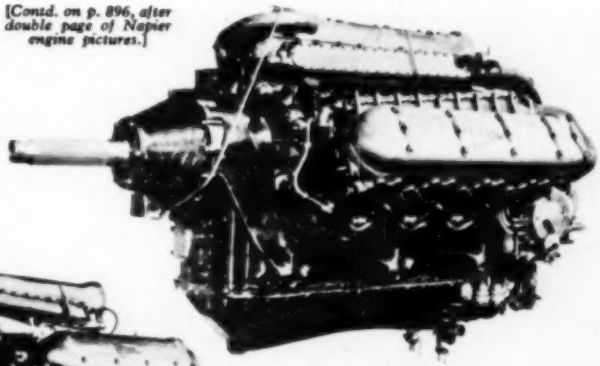
Napier have also played a part in the development of rocket motors for missiles and aircraft, and their Double Scorpion was largely responsible for a height record of 70,310ft set up by a Canberra in August 1957. In co-operation with the National Gas Turbine Establishment the company has been engaged upon an extensive programme of ramjet research and development, and one test vehicle has "coasted" to a height of nearly 20 miles.

LION

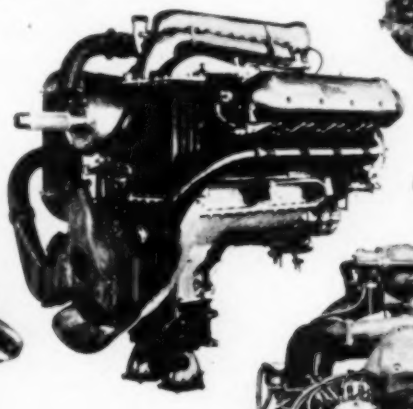
A TWELVE-CYLINDER water-cooled engine of "W," or "broad arrow," form, i.e., having the cylinders arranged in three banks of four each, there being an angle of 60 deg between the vertical bank and each lateral bank. Usually geared.

Variants—*Lion I:* First production series, geared but unsupercharged, and rated at 450 h.p. at 1,925 r.p.m. Possibly of slightly greater bore than prototype engines. Weight, 860 lb approx. *Lion IA:* A slightly modified version. May have differed from Lion I in having separate water jackets. *Lion IAY:* Believed used for turbo-supercharging experiments. *Lion II:* Compression ratio increased to give slight improvements in power and economy. *Lion IIA:* Slightly modified version of Lion II. *Lion IIB:* Another slightly modified version of the Lion II. *Lion III:* Possibly the racing engine for Supermarine Sea Lion III. *Lion IV:* An experimental, geared engine installed in two of the three Gloster Gorcocks. *Lion V:* A very widely used series of Service engine which remained in production until 1928, when it was succeeded by the Lion XI series: 470 h.p. at 2,000 r.p.m.; 500 h.p. at 2,250 r.p.m.; weight, 970 lb. *Lion VA:* Compression ratio raised from 5:1 to 5.8:1. Normal r.p.m. raised to 2,250 (500 h.p.) and maximum to 2,475 r.p.m. (520 h.p.). *Lion VA (N.S.):* Lions of this sub-series differed from the standard Lion VA in having a petrol pump incorporated in the design. The letters "N.S." signified "non-standard." *Lion VS:* Adapted for Roots blower, made by Allison, and installed for trials in

[*Contd. on p. 896, after double page of Napier engine pictures.*]

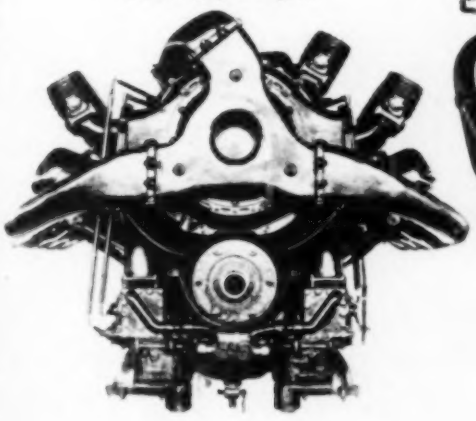


Lion XIA.

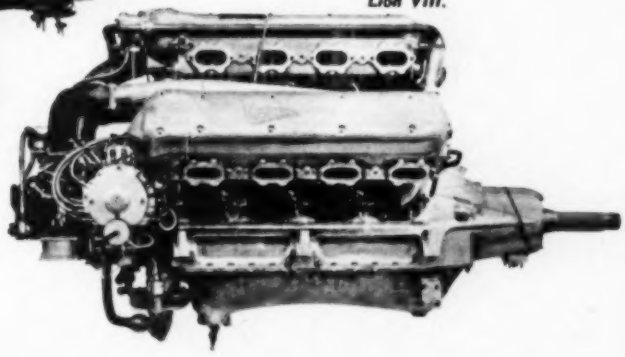


Lion V (with turbo-supercharger).

Lion VI (supercharged).



Lion VIII.



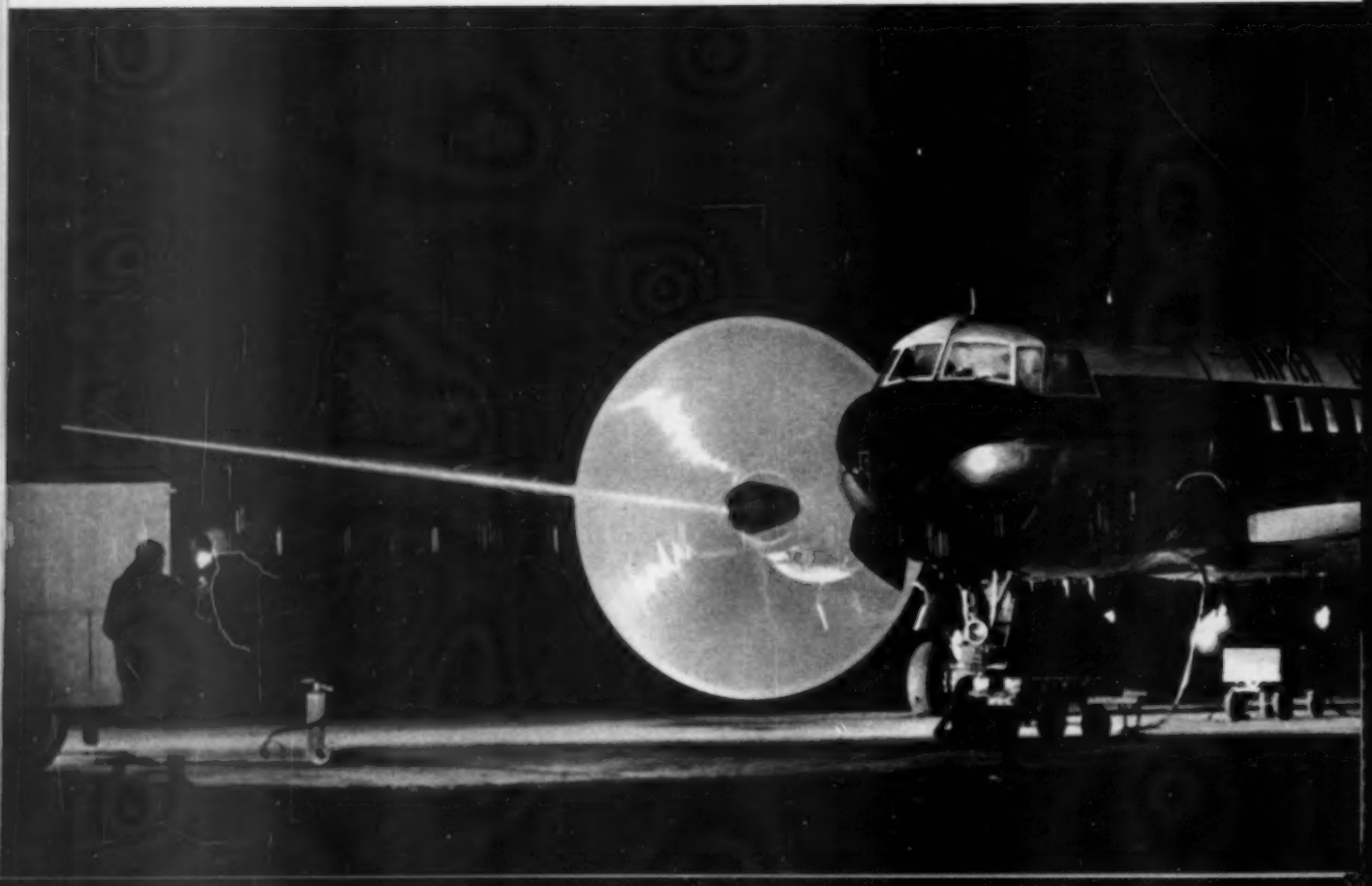
NAPIER Aero-Engines . . .

SOME CONTRA

Below, Supermarine S.5.

Scorpion-Canberra.

Eland

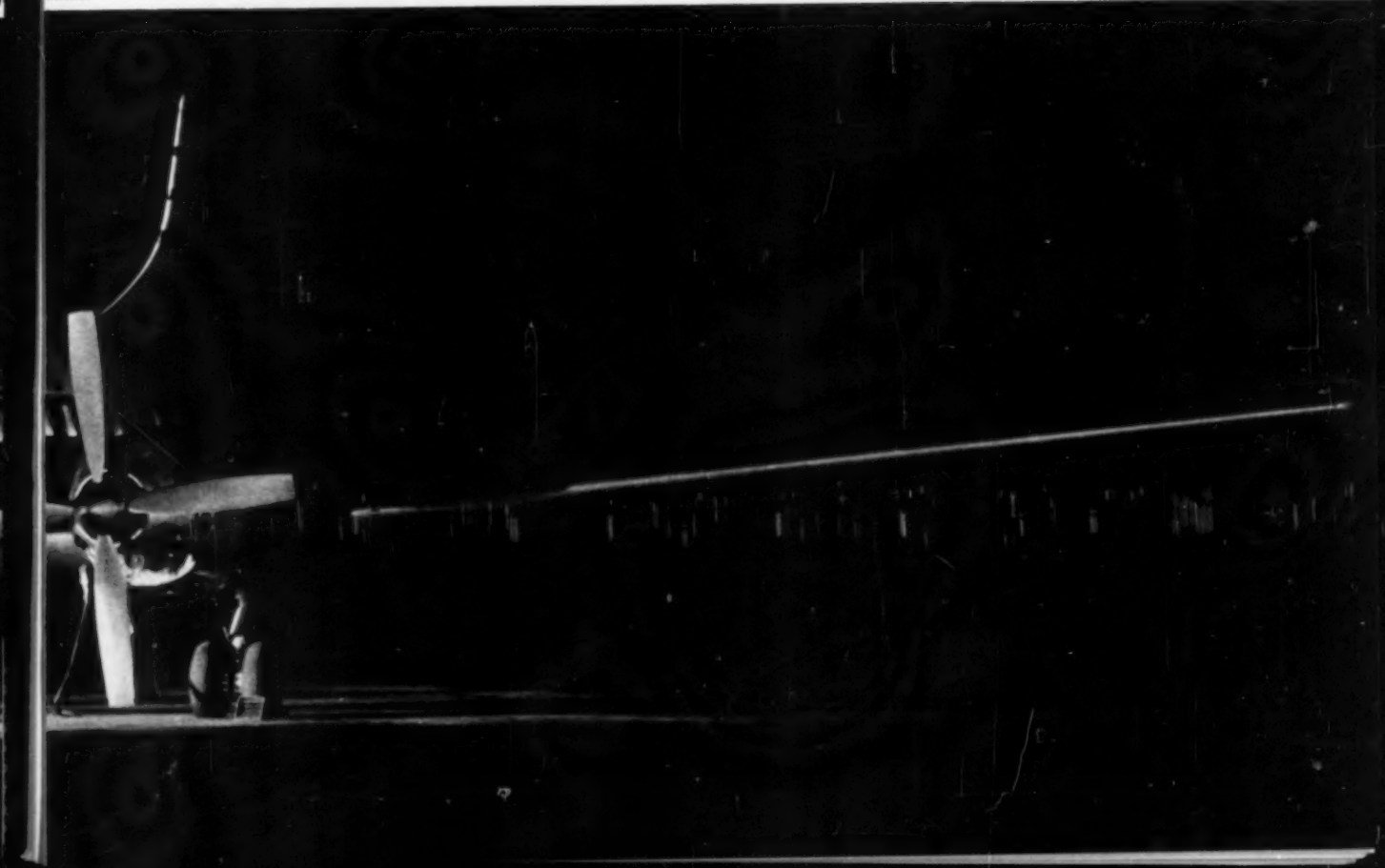


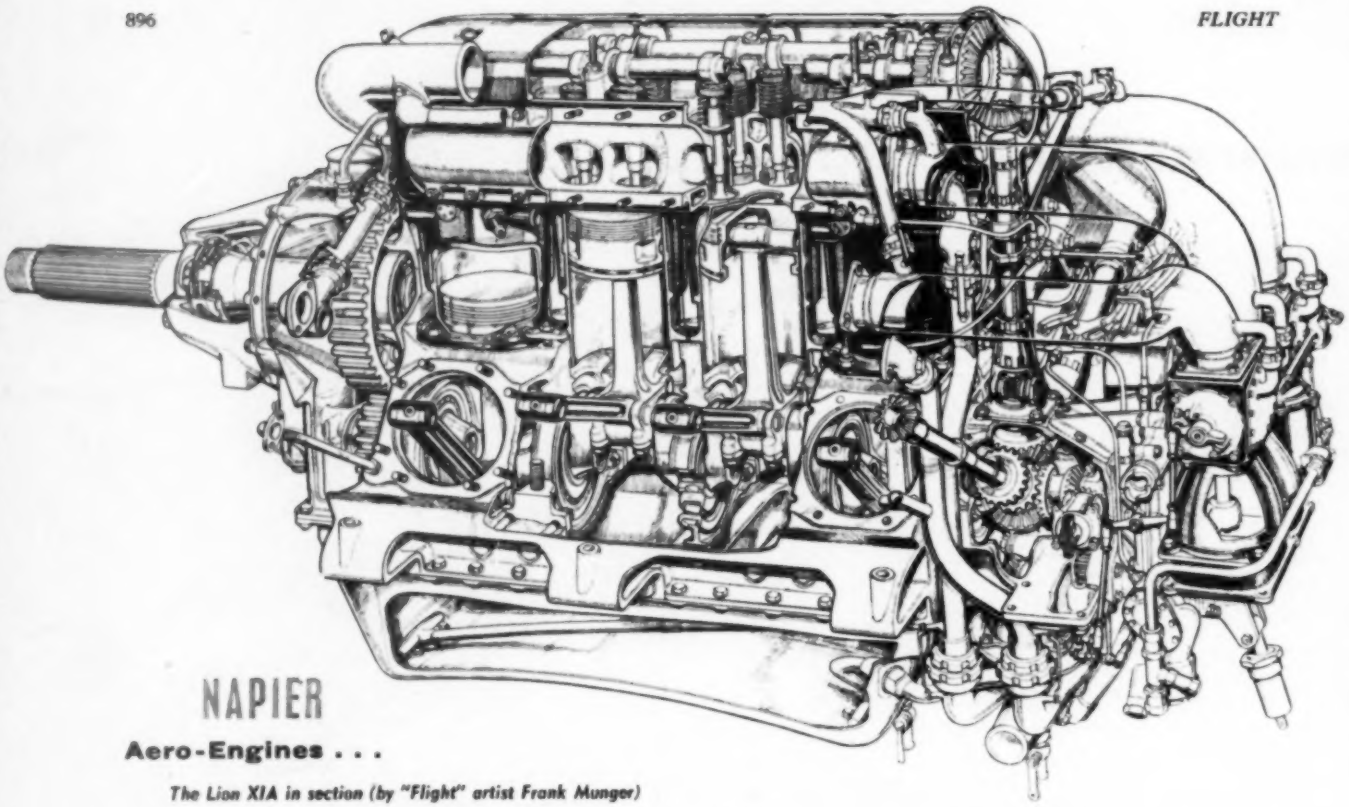
STING APPLICATIONS

"Flight" photograph

Fairey Rotodyne.

nvair.





NAPIER

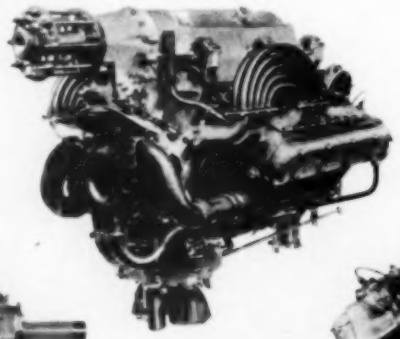
Aero-Engines . . .

The Lion XIA in section (by "Flight" artist Frank Munger)

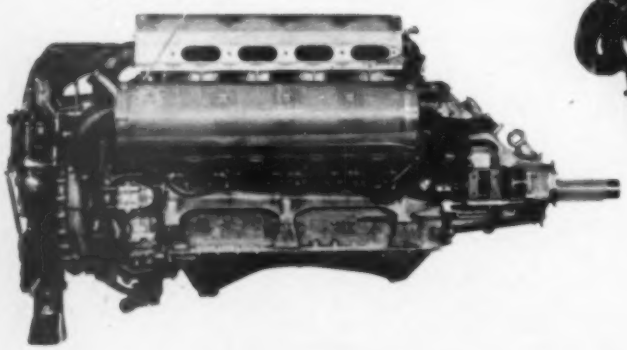
D.H.9. Lion V also had turbo-supercharger (see page 893). *Lion V* (five star):* Another Service variant. *Lion VI (E.75):* A direct-drive engine; compression ratio 5.8 : 1. *Lion VI (Supercharged):* A turbo-supercharged development, thought to have been installed in the Gloster Guan. *Lion VII:* The direct-drive racing engine in the Supermarine S.4 and Gloster III. 600 h.p. *Lion VIIA:* A direct-drive high-compression (10 : 1) racing engine. Decreased frontal area; maximum power, 900 h.p. at 3,300 r.p.m.; weight, 850 lb. Fitted in Gloster IV and IVA and Supermarine S.5. *Lion VIIB:* Similar to the VIIA but geared. Maximum power, 875 h.p. at 3,300 r.p.m.; weight, 930 lb. Fitted in Gloster IVB and Supermarine S.5. *Lion VIID:* Similar to VIIB but of higher power (1,320 h.p. at 3,600 r.p.m.) and of more compact dimensions. Also with supercharger. *Lion VIII:* A direct-drive engine, intended for fighters. 535 h.p. at 2,350 r.p.m.; 560 h.p. at 2,585 r.p.m.; weight, 930 lb; compression ratio, 6½ : 1; carburettors moved to rear. *Lion IX:* Possibly the engine of the Avro Avenger in 1928. *Lion X and XA:* Reported in Avro Buffalo, Fairey IIIF and Supermarine S.5. *Lion XI:* A geared and unsupercharged general-service engine giving 540 h.p. at 2,350 r.p.m. and 580 h.p. at 2,585 r.p.m.; weight, 980 lb; compression ratio, 6½ : 1. *Lion XIA:* Later version of the Lion XI. *Lion XIA (Special):* Specially tuned for Fairey long-range monoplane; slightly raised compression. *Lion XV:* A geared and unsupercharged engine giving 560 h.p. at 2,350 r.p.m. and 605 h.p. at 2,600 r.p.m.; weight, 1,013 lb.

Installations—*Great Britain:* Alliance Seabird and Endeavour. Armstrong Whitworth Siniai and Awana. Avro Racer, Bison, Avenger, Buffalo. Beardmore Inverness. Blackburn Blackburn, Pellet, Swift, Dart, Velos, Ripon. Boulton Paul Bourges, Atlantic, Bolton, Bodmin, Bugle. de Havilland D.H.9, D.H.4R, D.H.9A, D.H.9R, D.H.14, D.H.14A, D.H.16, D.H.18, D.H. Doncaster, D.H.29 (civil), D.H.34, D.H. Hound. English Electric Kingston, Ayr, Cork. Fairey IIIC, IIID, IIIF, Pintail, Fawn, Long-Range Monoplane. Gloster Bamel, Gloster I, II, IIIA, IIIB, IV, IVA, IVB, VI, Gorcock, Guan. Handley Page V.1500, W.8, Hanley, Hyderabad, Hendon, W.10, Harrow, Hinaidi. Parnall Puffin, Possum, Pike. Supermarine Sea Lion, Sea Eagle, Seal, Swan, Seagull, Southampton, S.4, S.5. Tarrant Tabor. Vickers Vernon, Vimy, Viking, Vanellus, Virginia, Victoria, Vulcan, Vixen, Valparaiso, Vivid, Venture, Vulture. Westland Walrus, Six-seat Limousine, Dreadnought. *Germany:* Dornier Wal and Superwal. *Netherlands:* Fokker C.IV, D.C.1, F.VII, D.III. *Sweden:* Heinkel HD.17, HE.5. *U.S.A.:* Kirkham flying-boat. *Czechoslovakia:* Smolik racing monoplane.

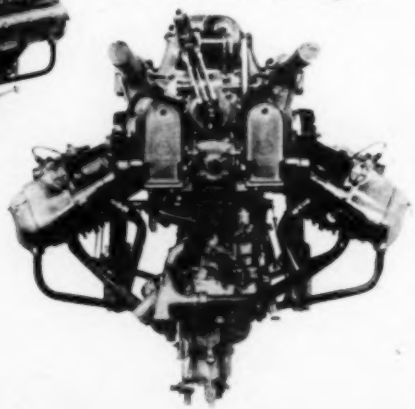
Right, Lioness (with turbo-supercharger).



Below, Lion VIID.



Below, Lioness (unsupercharged).



LIONESS

AN inverted version of the Lion, intended to improve the pilot's forward view. Compression ratio 5.8 : 1; geared but unsupercharged. Normal, 470 h.p. at 2,000 r.p.m.; maximum, 500 h.p. at 2,200 r.p.m. Weight, 1,000 lb. This engine has been confused with the Lion "S," a designation which was a contraction of (e.g.) Lion VS—the "S" signifying "supercharged." A picture on page 896 proves that a supercharged Lioness was, nevertheless, built. It has been stated that a Lioness was installed in a Fairey Fawn, but there is no photographic evidence of this, though it is positively known that a supercharged "upright" Lion was fitted.

CUB

A SIXTEEN-CYLINDER water-cooled engine with the cylinders arranged in four banks of four. The angle between the two upper banks was very much smaller than that between the two lower banks, and the angle between the upper and lower banks on each side of the centreline was 90 deg. A rated output of 1,000 h.p. at 1,800 r.p.m. was claimed, and the first version was geared. Later an ungeared type appears to have been developed. Installed in an Avro Aldershot and in two Blackburn Cubaroos.

JAVELIN

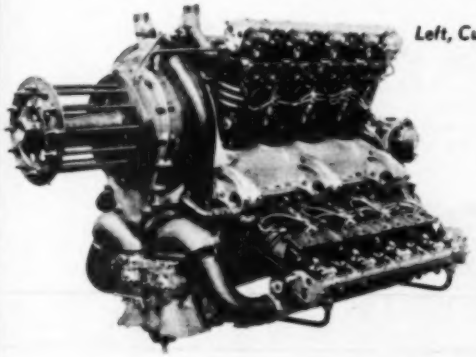
A SIX-CYLINDER inverted in-line air-cooled engine known by the Napier model number E.97. Direct drive; unsupercharged.

Variants—*Javelin I:* Presumed to have been a development engine. Rating believed to have been 150 h.p. at 2,000 r.p.m. and 170 h.p. at 2,300 r.p.m. *Javelin IA:* Series known to have existed. *Javelin II:* Normal power, 155 h.p. at 2,100 r.p.m.; maximum power, 170 h.p. at 2,400 r.p.m. Weight, 397 lb. *Javelin III:* Stroke increased from 5.25in to 5.5in. Normal power, 160 h.p. at 2,100 r.p.m.; maximum power, 172 h.p. at 2,325 r.p.m. Weight, 425 lb. *Javelin IIIA:* Fitted with a Rotax generator and starter-motor. Weight, 448 lb.

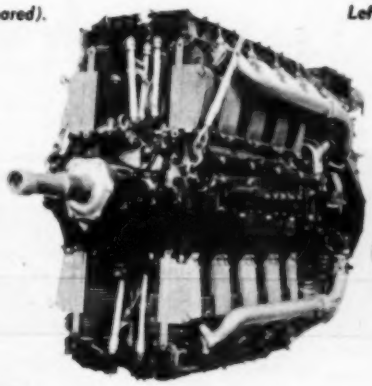
Installations—*Great Britain:* British Klemm Eagle. Percival Gull Four II and Mew Gull I. Martin-Baker MB.1. Spartan Arrow. *Australia:* Wackett Codock.

CULVERIN

A LICENCE-BUILT version of the Junkers Jumo 204, being a two-stroke, compression-ignition engine with two opposed pistons in each of its six vertical cylinders. Two crankshafts. International rating, 720 h.p. at 1,700 r.p.m. Weight, 1,785 lb approx. (N.B.—The Jumo 205 licence was also acquired and the

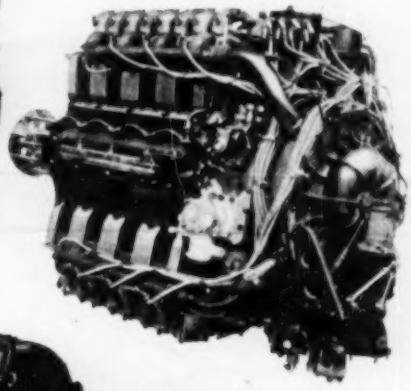


Left, Cub (ungeared).

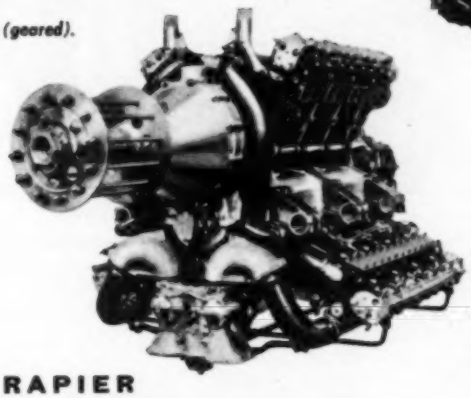


Left, Rapier VI.

Below, Rapier II.



Right, Cub (geared).

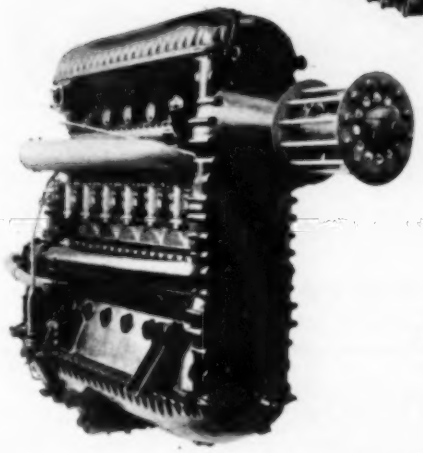


RAPIER

A SIXTEEN-CYLINDER air-cooled engine with four rows of four cylinders arranged (when viewed end-on) in the form of a letter H. Geared and supercharged.

Variants—*Rapier I:* Development engine. Rated output 300 h.p.; weight, 640 lb. *Rapier II:* A normal output of 305 h.p. at 3,500 r.p.m. at 10,000ft; maximum output 355 h.p. at 3,900 r.p.m. at 10,000ft. Weight, 720 lb. *Rapier IV:* This engine differed from the Rapier II only in supercharger gear ratio. Its normal output was 340 h.p. at 3,500 r.p.m. at sea level and its maximum output 385 h.p. at 3,900 r.p.m. at sea level. *Rapier V:* A development engine for the Rapier VI. Connecting rods of forked and plain-rod type instead of articulated. Strengthened crankcase, of magnesium alloy. Reduction-gear casing separate casting instead of integral. Oil pumps rearranged; downdraught carburettor. Automatic ignition timing. *Rapier VI:* Generally as Rapier V. International power 360 h.p. at 3,500 r.p.m. at 4,000ft; maximum power 395 h.p. at 4,000 r.p.m. at 5,800ft. Weight, 707 lb.

Installations—*Great Britain:* Airspeed Courier. Blackburn HST.10. Bristol Bulldog (test bed). de Havilland D.H.77. Fairey Seafox. Saunders-Roe Cloud. Short Mercury.

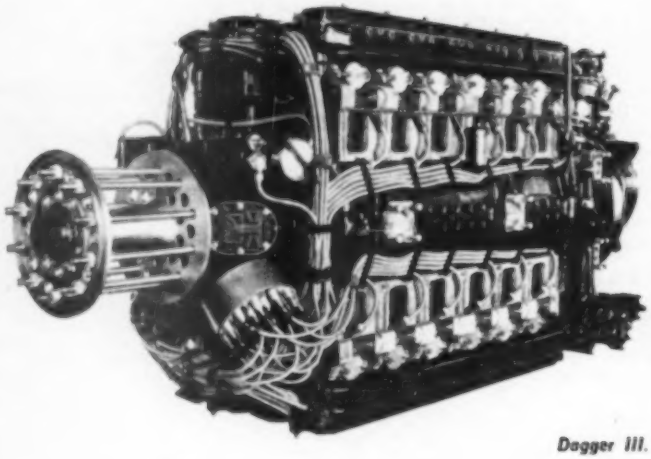


Left, Culverin.

Right, Javelin.

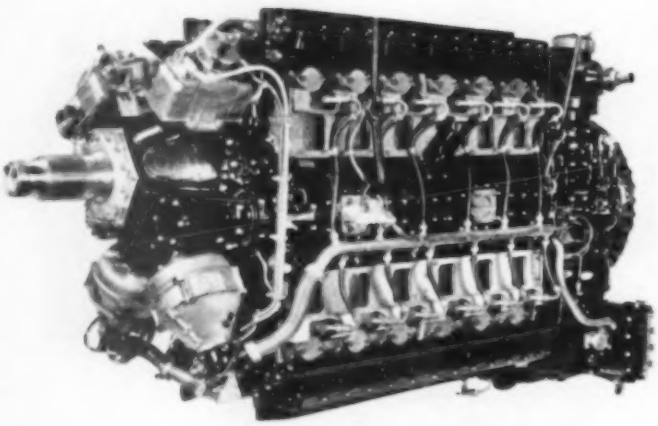
NAPIER

Aero-Engines . . .



Dagger III.

Dagger VIII.



name Cutlass was conferred, but no engine of this type was actually constructed by Napier.)

Installations—*Great Britain:* Fairey IIIF and Blackburn Iris. (Both aircraft were test-beds.)

DAGGER

A TWENTY-FOUR-CYLINDER air-cooled engine, with the cylinders arranged in four rows of six. Two crankshafts. Geared and supercharged.

Variants—*Dagger II:* A fully supercharged version, having a normal rating of 670/695 h.p. at 3,500 r.p.m. at 10,000ft, and a maximum rating of 725/755 h.p. at 4,000 r.p.m. at 12,250ft. Weight, 1,305 lb. Installed experimentally in Hawker Hart. *Dagger III:* A medium-supercharged version, having a normal rating of 700/725 h.p. at 3,500 r.p.m. at 3,500ft, and a maximum rating of 780/805 h.p. at 4,000 r.p.m. at 5,000ft. *Dagger VIII:* Bearing the Napier model number E.108, this engine was a fully supercharged version, rated at 890/925 h.p. at 4,000 r.p.m. at 9,000ft and having a maximum power of 1,000 h.p. at 4,200 r.p.m. at 8,750ft. The accessories were rearranged, the finning was of closer pitch, the propeller shaft was raised, and there was provision for a de Havilland variable-pitch propeller. The supercharger was of double-entry type.

Installations—*Great Britain:* Fairey Battle (test-bed). Handley Page Hereford. Hawker Hart (test-bed). Hawker Hector. Martin-Baker MB.2.

SABRE

A TWENTY-FOUR-CYLINDER liquid-cooled engine of "horizontal H" formation; geared and supercharged; two crankshafts.

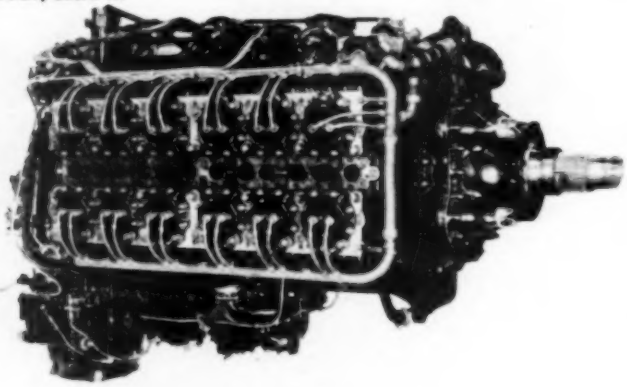
Variants—*Sabre I:* A development engine installed in three Folland 43/37s and Typhoon prototype. *Sabre II:* Production version for Hawker Typhoon. Maximum power 2,200 h.p. at 3,700 r.p.m. Weight, 2,360 lb. *Sabre IIA:* Position of sparking plugs changed. Extensive production. *Sabre IIB:* Up-rated to 2,400 h.p. for take-off. *Sabre IIC:* Some engines of this designation were installed in Tempest TT.Vs. *Sabre III:* Variant installed in the Blackburn Firebrand. *Sabre IV:* Intended for the Blackburn N2/42 flying-boat. *Sabre V:* Production development of Sabre II. *Sabre VA:* Two-speed supercharger. Rated power 2,165 h.p. at 3,650 r.p.m. at 6,500ft (moderate supercharge); maximum power 1,930 h.p. at 3,600 r.p.m. at 15,750ft (full supercharge). Weight, 2,500 lb. *Sabre VI:* Modified version of the VA, adapted for an annular nose radiator with engine-driven cooling fan. *Sabre VII (N.S.93 S.M.):* Another development of the VA with water/methanol injection and local strengthening. Combat power 2,760 h.p. at 12,500ft. *Sabre VIII:* Intended for the Hawker Fury. Nearly 4,000 h.p. on test. *Sabre Special:* For Heston Racer.

Installations—*Great Britain:* Blackburn Firebrand. Fairey Battle (two test-beds). Folland 43/37 (four test-beds). Hawker Henley, Typhoon, Tempest and Fury. Heston Racer. Martin-Baker MB.3. Vickers-Armstrongs Warwick.

NAIAD

A TURBOPROP with twelve-stage axial compressor, two-stage turbine and five combustion chambers. 1,500 e.h.p. at 18,250 r.p.m. Installed in Lincoln flying test-bed. (N.B. A Coupled Naiad was projected but was not run.)

Below, Sabre II.



Sabre installation in Hawker Typhoon.

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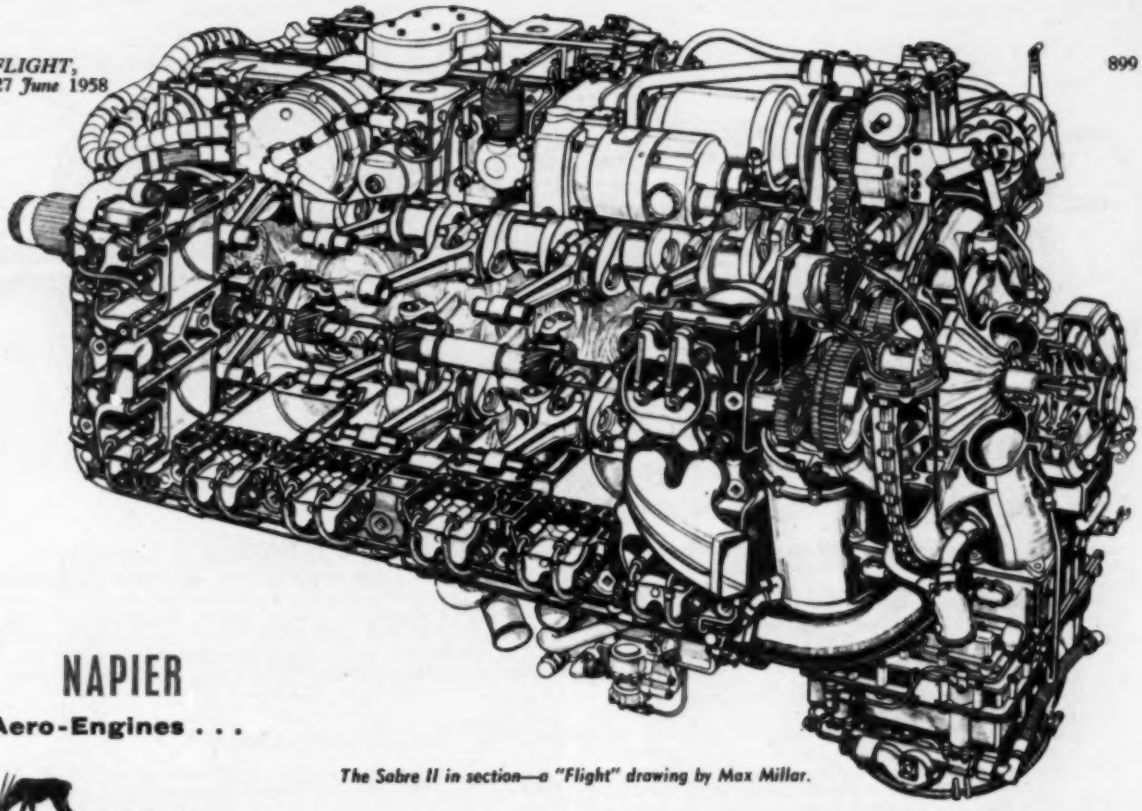
Remarkable performance and outstanding economy in operation are features to be expected where Alvis Leonides provide the power.

ALVIS **LEONIDES AERO ENGINES**

ALVIS LIMITED COVENTRY ENGLAND



NAPIER

Aero-Engines . . .

The Sabre II in section—a "Flight" drawing by Max Millar.

ORYX

A GAS generator unit for helicopters, its function being to supply a steady flow of hot gas, at a relatively low pressure, to a power-producing section remote from the engine itself. Axial compressor and five combustion chambers. 750 gas h.p. at sea level. NOr.1 installed in Hunting Percival P.74.

NOMAD

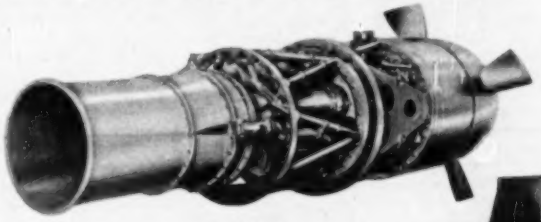
A COMPOUND gas turbine/diesel engine. Two-stroke, liquid-cooled, with twelve valveless cylinders coupled with axial compressor and exhaust-gas turbine, all delivering power at a single propeller shaft. Installed in Lincoln flying test-bed. A proposed application to the Avro Shackleton was abandoned.

Variants—There were numerous versions and ratings, but the principle variants were as follows. *Nomad 1:* First-stage compressor had ten stages; second-stage compressor was centrifugal. One-stage main turbine and one-stage auxiliary turbine. Two co-axial propeller shafts. 3,080 e.s.h.p. Weight, 4,200 lb. *Nomad 2:* Twelve-stage axial compressor. Three-stage axial turbine. One propeller shaft. 3,570 e.s.h.p. Weight, 3,580 lb.

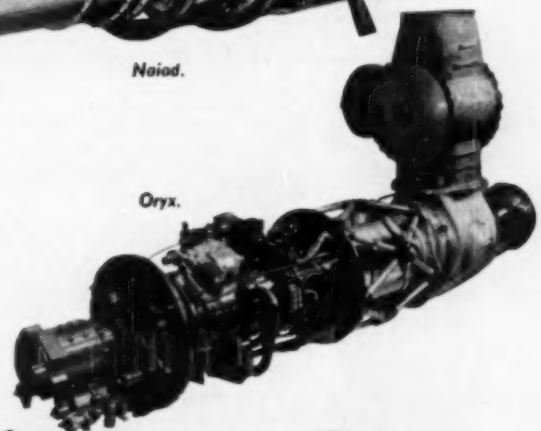
ELAND

A SINGLE-SHAFT turboprop originally developed for fixed-wing aircraft but now also applied to helicopters. Current type has ten-stage compressor, six combustion chambers and three-stage turbine.

Variants—*NEl.1:* The first development engine, with a take-off rating of 3,060 h.p. *NEl.3:* The engine for the Fairey Rotodyne prototypes. Comprises a basic Eland fitted with split exhaust ducts and a main shaft extended to the rear behind the turbine and driving an auxiliary compressor through an hydraulic coupling. This auxiliary compressor feeds air to pressure jets at the tips of the rotor blades. In cruising flight the rotor autorotates and all power is absorbed by the propellers. Dry weight, 2,350 lb; maximum power (forward flight), 3,000 e.h.p. at 12,500 r.p.m. *NEl.4:* A development of the NEl.1, designed to operate at higher



Naiad.



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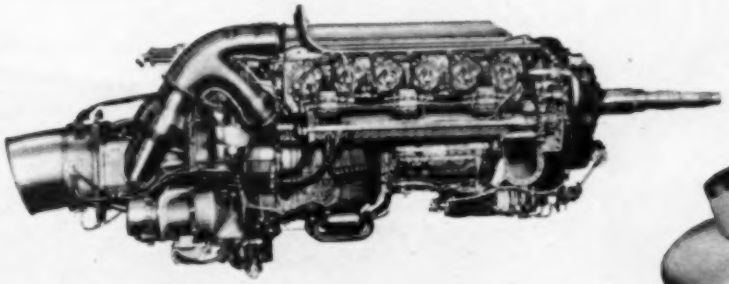
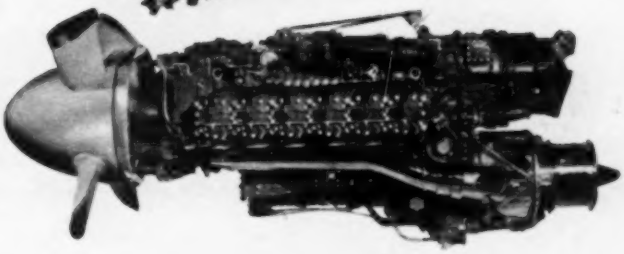
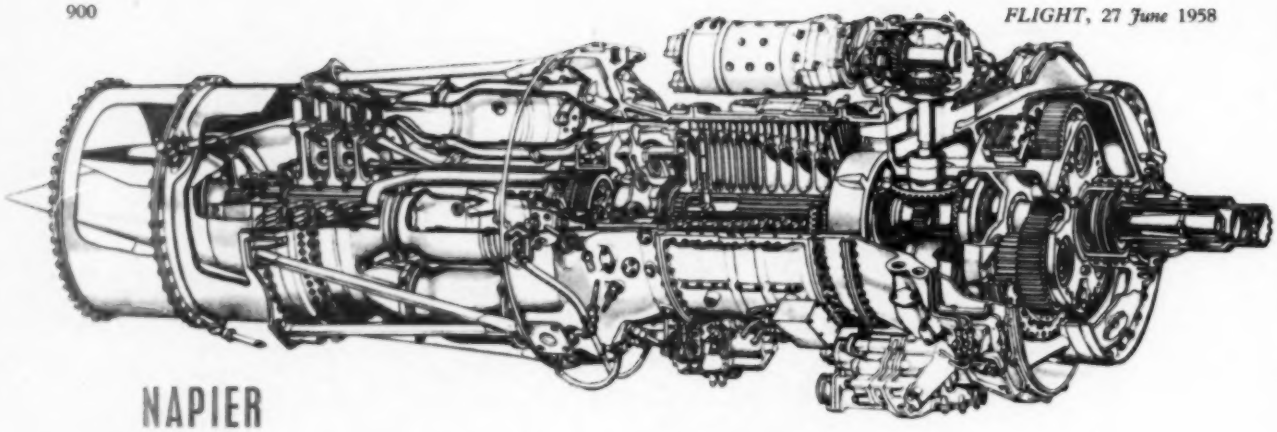


Above, Nomad 1.



Right, Nomad 2.



NAPIER

Aero-Engines . . .

The Eland in section, by "Flight" artist R. E. Poulton.

temperatures. Air-cooled turbine blading. Take-off power 4,000 e.h.p. *NEl.5:* A development of the NEl.4, with increased mass flow and raised compression ratio (8:1). Take-off power 4,200 e.h.p. Originally intended for the Westland Westminster. *NEl.6:* The latest "fixed-wing" Eland, with improved turbine blades, permitting higher operating temperatures, and increased mass flow. 3,500 e.h.p. at 12,500 r.p.m. *Eland 229:* This is the engine for the Westland Westminster, with rear drive and an hydraulic clutch similar to that fitted to the NEl.3. Rating 2,800 s.h.p.

Installations—*Great Britain:* Airspeed Ambassador (test-bed). Fairey Rotodyne. Vickers-Armstrongs Varsity (test-bed). Westland Westminster. Eland-Convair (Model 340-2 Convairliner). *West Germany:* Hamburger HFB-C-209. N.B. The Eland will also be installed in the Canadair CL-66 (Canadair 540), and design studies are in hand for the conversion of various Convair, Lockheed and Douglas airframes.

GAZELLE

DESIGNED from the outset as an omni-angle engine for helicopter propulsion. A free-turbine shaft-drive engine, with eleven-stage compressor, six combustion chambers, two-stage compressor turbine and single-stage power turbine.

Variants—*NGa.1:* A development Gazelle having an emergency rating of 1,260 s.h.p. *NGa.2:* This is the engine for the Bristol Type 192 helicopter and has an emergency rating of 1,650 h.p. In the Type 192 the engine is installed at an angle 7 deg from the vertical. *NGa.3:* The emergency rating increased to 1,800 s.h.p. (5 min) at 20,400 compressor r.p.m. *NGa.4:* a development engine having an emergency rating of 2,000 s.h.p. *NGa.13:* This is essentially the NGa.3. The addition of the figure 1 before the 3 indicates that the engine output-shaft turns in a direction contrary to that of the original Gazelle, this change having been made merely by providing "mirror-image" blading on the power turbine. The NGa.13 is the engine for the Westland Wessex.

Installations—Bristol Type 192. Westland Wessex.

GAZELLE JUNIOR

A SMALLER version of the Gazelle, now under development. Napier will also offer this as a coupled engine, so that the larger type of single-engined helicopters may be converted to twin configuration. The initial engine will have a sea-level static maximum rating of 920 s.h.p., which will be increased, with development, to 1,070 s.h.p. Basic weight, 495 lb.

SCORPION

A LIQUID propellant rocket using high test peroxide and kerosine. Produced in twin-chamber form as the Double Scorpion.

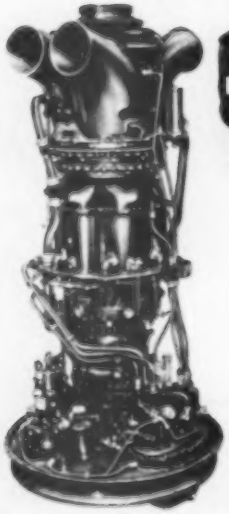
Variants—*NSc.1:* A development engine air-tested in an English Electric Canberra. *NScD.1:* Development model of the Double Scorpion, also installed in a Canberra. Intended for ultimate installation in belly fairing on the English Electric P.1 fighter.

OTHER NAPIER ROCKETS

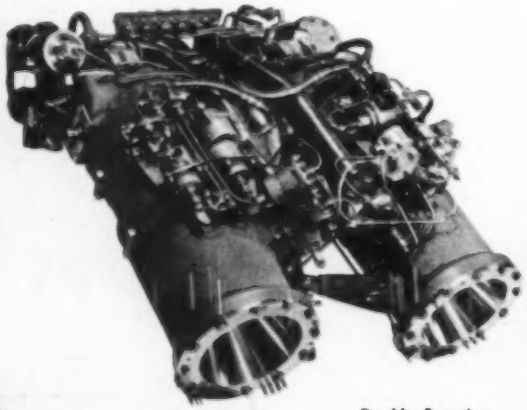
FOR several years Napier have been engaged in developing rocket motors not only for aircraft, but for missile and other applications, e.g., the NRE 11, 17 and 19. The last-named is one of several miniature rockets and has been used—in an "ROR" installation—for increasing the rate of climb of the Saunders-Roe Skeeter helicopter.

RAMJETS

SINCE 1950 Napier have been major sub-contractors to the National Gas Turbine Establishment in the design and manufacture of supersonic ramjet vehicles. The RJTV (ramjet test vehicle) which, it was announced last January, had reached Mach 2.3 and had coasted to 114,000ft, was one of a large number built at the company's Flight Development Establishment at Luton, Beds. It had a double-shock intake with a conical centre-body. It measured 20ft in length and was 18in in diameter.

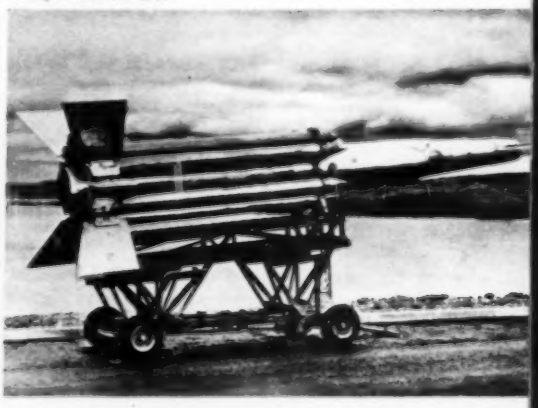


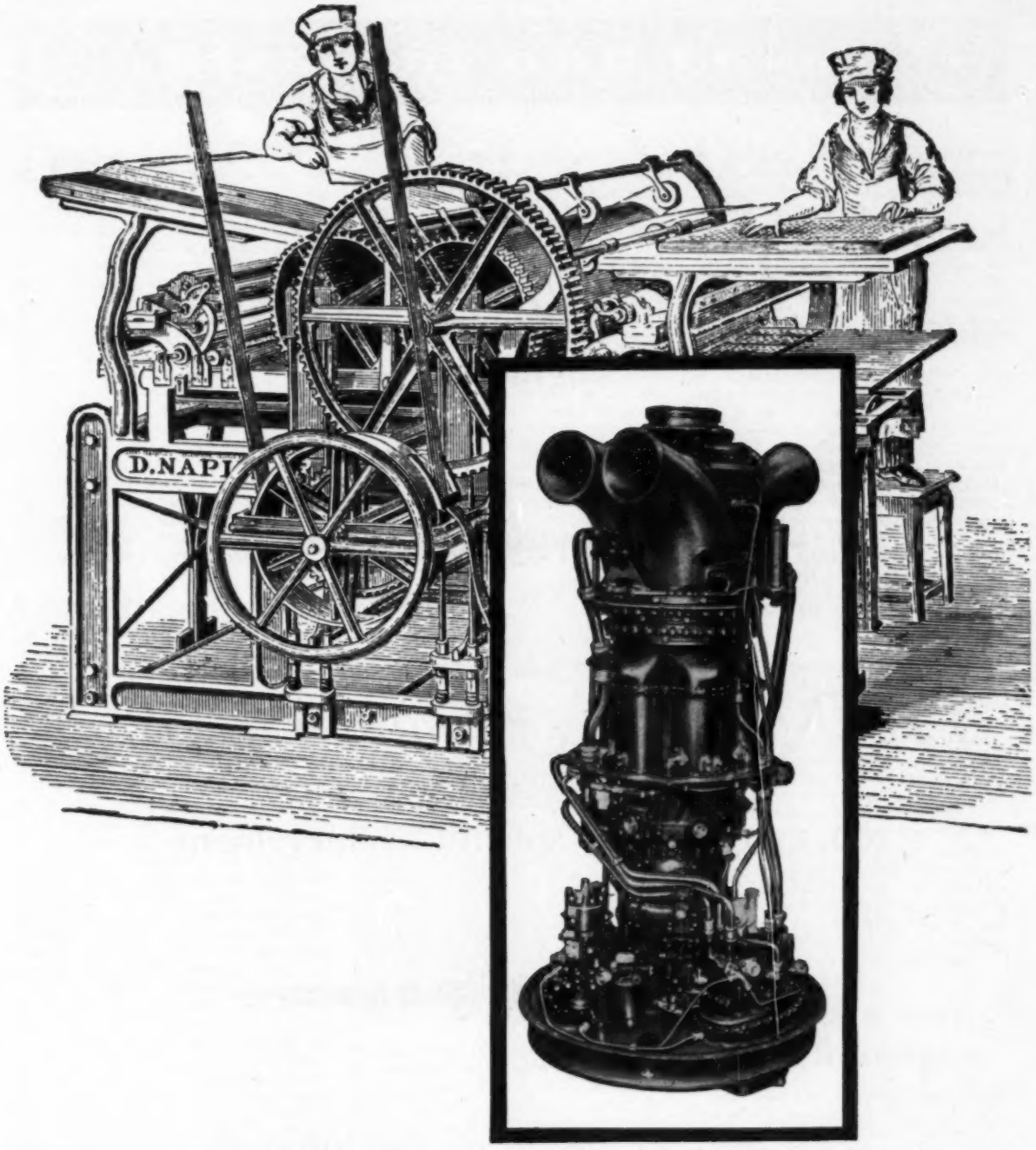
Gazelle.



Double Scorpion.

Ramjet test vehicle.





Congratulations to Napiers who have made a magnificent job of putting the engine into engineering for 150 years

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D. Napier & Sons Limited

on 150 years of splendid achievement

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Straight and Level

ONE gets so accustomed to moans from Britain's independents that it is refreshing to hear of one which recognizes the facts of British air transport life and makes the most of them. I should like to mention names, but perhaps I shouldn't. The independent concerned, while as dissatisfied as any other with the structure of British air transport, has a philosophy which might be expressed thus: "We are not one of those who think that the Corporations are inefficient, and we do not aspire to taking over their business. It is easy to say that we would do their job more efficiently, but to talk like this is provocative, and no way to win friends."

Unusual talk, and probably unrepresentative of independent-operator opinion. But it is a point of view worth noting, because this philosophy has made the airline concerned into a very successful and respected one.

● You recall my quoting the U.K. Guild of Air Traffic Control Officers to the effect that men in the tower are today working "on the edge of reason"? I thought of these words when I heard about the effect which the recent collision between a Capital Airlines' Viscount and a T-33 is reported to have had upon three Washington air traffic controllers.

The control tower supervisor, Austin M. Stampf, apparently had a nervous breakdown while preparing paper-work on the accident, and is now having psychiatric treatment. A controller named Charles A. Laymon has collapsed twice and is now in hospital. The controller who was directly in charge of the Capital Viscount at the time of the collision has been given sick leave and will probably seek a transfer.

Guilds and Associations and other bodies can utter as many warnings as they like: but it is only when you hear about controllers actually cracking up under the load of their responsibilities that you *really* realize the magnitude of the A.T.C. problem. It is quite likely that these men were not in any way at fault; but it is a bad thing that any man's livelihood, not to mention the lives for which he is responsible, should be in danger because a system is wrong.

● In a recent *Flight* editorial it was said that all hopes for the future of collision-avoidance rest upon the fact that in the Western systems of government it is *civil* law which must prevail.

It looks as though this is being asserted in America: I think that what may come out of the present A.T.C. furore over there is that a new Federal Aviation Agency, responsible to President Eisenhower and to Congress, will assume the A.T.C. responsibilities at present borne by the Civil Aeronautics Administration and the Airways Modernization Board. It will, as proposed, be headed by a *single civilian administrator*, with power to regulate both civil and military traffic.

That's the stuff. But pause to think of the exasperation this will cause to Service pilots. How would you like to be in a jet fighter squadron which has to wait so long to get a take-off clearance from—if you please—a civil controller that the mission has to be abandoned in disgust? This is now happening at U.S.A.F. training bases in America under the interim emergency system of civil control. But pause also to reflect on these wise words from the C.A.B.'s chairman: "Do not let us abandon what we have, good or bad, and replace it with a shiny new agency that will somehow, magically, produce absolute safety in the air."

● Last week my reporter interviewed the famous veteran pilot, Capt. Dorset Horn (pictured above), on the subject of flight engineers, and their place in the airliner cockpits of the future.

The captain said: "Baa-baa" and butted his horns through the windscreen.

● Mr. Frank Tomney [in the recent Commons debate on the aircraft industry]: "In this respect, my right hon. Friend . . . is at cross-purposes with himself, since he also supports agriculture. For my part, if it is a question of bigger and better onions and bigger and better carrots against bigger and better aeroplanes, I am all for the bigger and better aeroplanes."

Mr. George Brown: "It will give my hon. Friend indigestion."

Mr. Tomney: "We will make more money. That is what we must consider."

● *B.O.A.C. Spokesman* (quoted by *The Times* on April 11): "The resale of Stratocruisers is not connected with the purchase of the Boeing 707s."

Mr. William Allen, president of Boeing, in a statement to shareholders (recently quoted by *Aviation Daily*): "I do not know whether Boeing can dispose of the 14 Stratocruisers returned by B.O.A.C. at the same modest allowance made to B.O.A.C. on its 707 order."

● *"Unless Britain puts up her own Sputniks and spaceships she will indeed be a third-class Power."*

Thus was Sir Robert Renwick, president of the Radar and Electronics Association, recently quoted. I suggest that, if we *do* put up our own Sputniks and spaceships, we shall be a fourth-class power at least, because the cost of these toys will bankrupt us.

The implication, incidentally, is that we are already a second-class power. Measured by what values? So far as I am concerned Britain is a first-class power.

● Congratulations to Lockheed on landing an order from the U.S. Navy for 80 sub-hunter versions of the Electra; now, I suppose, they are all set for a similar number of ambulance/crew-trainer/transport versions for the U.S. Air Force. The effect of this on Lockheed's ability to market the airliner will, to put it mildly, be considerable.

What a curious thing that the only Viscount ever to bear R.A.F. markings should have been the old 630 prototype, G-AHRF, which once bore Service (M.o.S.) livery before being painted in B.E.A. colours. Anybody care to take me on if I say that the R.A.F. will buy the Vanguard? VC.10? D.H.121?

● *Baggage may beat Rotodyne*

This was the big front-page headline which shocked me into buying the midday *Evening Standard* recently. All of a tremble, I read: "The Abergavenny Plate (3.30) at Lewes this afternoon is the most interesting race. . . . Baggage is fancied, and may win from Rotodyne."

I read on: "Rotodyne is a neat, well-balanced sort. My Newmarket reports of her exercise spins are promising."

● "Most airlines," Trans-Caribbean's president has asserted, "spend too much money in non-transport directions. If they cut out these expenses and concentrated on transportation, they wouldn't have to cry so much."

ROGER BACON

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Light on History

AN interesting comment by Roger Bacon ("Straight and Level," May 30) brings up two historical problems upon which I may be able to throw a little light. He was good enough to quote me about the first manned helicopter flight. As the quotation shows, I was uncertain at the time (1952-53) and we have done a lot of work since then. In order to get this particular business cleared up I asked Charles Dollfus (curator of the Paris Musée de l'Air) and he tells me that although the Bréguet machine was in fact first off the ground, we must honour Cornu as the first to make (although only tentatively) the first free vertical flight in a helicopter, for the odd but decisive reason that the Bréguet machine rose with the ground staff steadying the rotor outriggers with poles, not to aid the lift but the stability: therefore it was not a free flight, and Cornu must have the honour.

Jatho, like Mozhaiski in Russia, is one of the new "discoveries" of history. By that I do not mean we think they are frauds, but that they have only just emerged. The best German authorities, I think you will find, only use the word *Flugsprung* for Jatho's kind of "flight." He was a shadowy figure, of no particular importance in aviation history, who was said to have made hops of 59ft and 197ft respectively in August and November of 1903. The inscription, by the way, refers to him as a *Motorflieger* (pilot of a powered aeroplane), not as having made the first flight. In fact Ader was a *Motorflieger* long before (1890 and 1897) even though he didn't fly, and the great Lilienthal was a kind of *Motorflieger* in that he fitted powered ornithoptering wing-tips to one of his gliders in 1895-96.

London, W.1. CHARLES H. GIBBS-SMITH.

Aviation Policy

IT has often been asked, what is the aviation policy followed by the Government since the war? The question must remain purely rhetorical since even the Government doesn't know the answer. But one is perhaps justified in asking what is the policy now? It is clear that a manœuvre known as "contraction" is required of the industry by some person or persons unknown, and probably domiciled in Whitehall. Might one point out that dogmatic statements of labour strength, e.g., "150,000 men by 1960 or else," do not form a policy. The obvious way to obtain the optimum size of industry is surely by following an identifiable, coherent policy.

In fact there is no policy even now, for the simple reason that no complex of departments (each in their own separate building), such as the Treasury, Ministry of Defence, M.T.C.A., Ministry of Supply, and the Air Council, can ever decide on anything together at one and the same time. When they do the millenium will be here. The simple word for it is non-co-operation. There is no central control; no supreme technical and administrative authority. May I illustrate this by citing the fiasco of the V.1000? In 1952 the H.P.97 design was first brought to the public eye. It offered North Atlantic range, 600 m.p.h. performance, valuable self-landing qualities and 150-passenger accommodation.

It should be noted that B.O.A.C. has recently ordered, some six years too late, the VC.10, which does not appear to have the potential of the H.P.97. It has also allotted £44m to the purchase of Boeing aircraft. The point is that someone ordered the V.1000 in place of the H.P.97 although it was just 100 m.p.h. slower and had a heavier wing. Inevitably, it had to be cancelled. It just did not compete.

Who was the ineffable bureaucrat who perpetrated such a staggering piece of mismanagement? Does he ever calculate the probable loss to the country in hard currency and prestige? If the millions now to be paid to America had been used for developing the H.P.97 in 1952, is it not conceivable that we might now have a competitor for the DC-8 and Boeing 707? The product creates the market, not *vice versa*. It should be remembered that the decision to put the DC-8 into production was taken in June 1955. In June 1958 the first production model has flown. When the DC-8 and 707 were first sold to the airlines, they were "paper" aeroplanes; they had not even flown—a clear enough proof that markets are created by a product and not for it. Whitehall is going to wait till it sees a market before even finalizing a design.

To illustrate the attitude of one of our competitors in contrast to Whitehall may I quote from an article on Russia: "According to Gen. Thomas D. White . . . on development of a machine that has high priority, the Russians *no longer use the system of building one or two prototypes*. . . . When the most promising of a number of competitive designs has been selected, the production of a batch of ten or twelve test aircraft is initiated, production tooling being commenced *simultaneously*."

By contrast we are still building a prototype, e.g., the NA.39, without even a production order. The P.1A was another case in point, only one being in the air for the first two years of testing. Can we afford this Maginot Line mentality? Is it more important to save face than save money, where a supersonic failure is more embarrassing than a subsonic one for a Ministry?

May I finish on two points? The potential of an aircraft exporting industry is far greater than any other branch of exports. It could, with reasonable foresight and commonsense planning, have banished the fear of financial crisis from this country for ever. That chance, given once, just after the war, has gone. The proper baseline for high-speed research in the U.K., the M.52, was cancelled by the most perfect example of cold feet ever displayed by a government; another government is now fumbling the supersonic transport. But if we are ever going to pull out of the present trough, the pedants of the Air Staff and Defence Ministry must be over-ruled and Transport Command must play its part in giving our manufacturers a chance.

Ilkley, Yorks. JAMES PETER HARRISON.

"Gliding in Poland"

IN connection with my article "Gliding in Poland," which appeared in the June 13 issue of *Flight*, I would like to point out that the names of several Polish cities printed on the map of Poland were changed from the original into German, and that others were mis-spelled. In some cases names of Polish cities, which even before World War 2 were on the territory of Polish State, were replaced by artificially created German names, which were used officially only by German occupation authorities during the brief period of German occupation of Poland, and on some German-issued pre-war maps, serving the Nazi propaganda machine, claiming them to be German (i.e., Bromberg, Graudenz, Neu Sandec, etc.). This may be taken by your readers as a departure from your long-standing traditions of impartiality in matters of politics, and regarded as a deliberate propaganda on behalf of German revisionism. As the article in question appeared under my name, this is a serious matter to me personally, and I would like to dissociate myself with the map as printed.

I give below a list of the names of Polish cities as they appeared on the map originally sent by me to you, quoting in brackets incorrect names substituted when the map was redrawn: Bydgoszcz (Broberg), Elblag (Elbing), Elk (Lyck), Gdansk (Danzig), Grudziac (Graudenz), Gryzliny (Gryzlin), Inowroclaw (Inowroclan), Katowice (Katwice), Koszalin (Koslin), Lebork (Lanenburg), Nowy Sacz (Neu Sandec), Olsztyn (Osterode), Opole (Oppeln), Ostrow Wlkp. (Ostrow Wlkr.), Ostrowiec Sw. (Ostrow Sw.), Slupsk (Stolp), Sosnowiec (Sonsowice), Szczecin (Stettin), Tomaszow Maz. (Tomazow Maz.), Wroclaw (Wroklaw). In the article itself Jezow was twice mis-spelled as Jesow.

London, N.6. J. B. CYNK.

[Whilst regretting that the changes should have caused annoyance to our contributor we need hardly add that no political implication was intended. In order to place the towns accurately, our artist worked from a well-known British atlas published since the war—Ed.]

FORTHCOMING EVENTS

June	27.	D.H. Technical School Old Boys' Association: Midsummer Ball: Water End Barn, St. Albans.
June	27-29.	Royal Dutch Aero Club: International Rally.
June	28.	R.A.F.A. (S.W. Area): Flying Display, Exeter Airport.
June	28.	R.A.F.A. (Midland Area): Air Display, Staverton Airport, nr. Gloucester.
June	28.	R.N. Air Station Abbotsinch, nr. Paisley: At Home.
June	28-29.	Flers Aero Club: Normandy Rally.
June	28-30.	R.Ae.C.: Private Air Rally, La Baule.
July	4.	College of Aeronautics Students' Society: Presentation Ball, Cranfield.
July	5.	NATO Air Display: Soesterberg, Holland.
July	5-6.	Aéro Club de l'Ouest: Anjou Wines Rally.
July	5-7.	R.Ae.C.: Private Air Rally, Deauville.
July	8.	Kronfeld Club: Welcome home to British gliding team.
July	8-11.	Institute of the Aeronautical Sciences: National Summer Meeting, Los Angeles, Cal.
July	10-12.	R.Ae.C.: National Air Races and Lockheed International Aerobatic Competition, Baginton, Coventry.
July	12-14.	Royal Dutch Aero Club: Camping Rally.
July	13.	Wolverhampton Aero Club: At Home, Wolverhampton.
July	13.	Leicestershire Aero Club: At Home, Leicester East.
July	19.	R.N. Air Stations Eglinton (Londonderry) and Culdrose, nr. Helston, Cornwall: At Homes.
July	19.	Surrey Gliding Club: At Home, Lasham.
Sept.	1-7.	S.B.A.C. Display and Exhibition, Farnborough.

The Turbine Helicopter

A LECTURE ON WESTLAND EXPERIENCE : PART 2

The crane version of the Westminster. It first flew on Sunday, June 15.

WE reproduce here the second part of the lecture given by Mr. D. L. Hollis Williams, B.Sc., F.R.Ae.S., technical director of Westland Aircraft, Ltd., before the Helicopter Association on June 6. Part 1, which was mainly confined to comparisons between piston and turbine powerplants and between fixed and free turbines, was reported in our June 13 issue.

The Gazelle Installation in the Wessex. Development of the Napier Gazelle for the Wessex started in mid-1956. An American S-58 was purchased by Westland (later it was transferred to the Ministry of Supply) and some 76 hours of flight time was carried out with the Wright R-1820 engine. In November 1956 the helicopter was laid up, the piston engine removed and a Gazelle powerplant installed. The Gazelle had fortunately been designed to operate at any angle, so it was possible to mount it at the same inclined angle as the piston engine. Ground running began in March, the first flight was made on May 18, 1957, and to date about 100 hours of flight time, plus a large amount of ground running time, has been accumulated. In general the development was straightforward, and with one or two small exceptions nothing had to be designed into or out of the trial installation.

Reminding his audience that the Gazelle is a free turbine with rear drive, the lecturer said that as under development at the time it had the wrong direction of rotation for Westland's purpose. The problem of reversing the direction of rotation of an engine was usually a considerable operation, but—and this was a point in favour of the free turbine—Napier achieved this simply by providing mirror-image nozzle vanes and blading for the power turbine. No other changes were necessary, and engine performance was not penalized. Because the Gazelle engine was considerably lighter than the piston engine which it replaced, it was necessary to carry a large amount of ballast on the engine mounting for the first trial installation. For the production version it was necessary to achieve the same balance without ballast, and this was effected by transferring equipment from the rear of the cabin to a new stowage immediately over the turbine.

At the start of flight development an open intake was used; this caused a certain amount of anxiety and in due course in the early running period some compressor damage was found, which from marks on the blades was thought to have been caused by part of a split pin. A system of guards was therefore built up until a plenum chamber modelled on the production version was installed and this formed a crude momentum separator, which so far seemed to have been effective.

After some initial development work in which three turbines were used alternately, it was possible to settle down and do a clean run of 25 hours on one turbine and then a clean 50 hours' run on the next turbine.

With regard to noise, there was no doubt that the Wessex with the Gazelle was very much quieter than the S-58 with the Wright R-1820. The R-1820 was one-sided with respect to its exhaust, but the exhaust of the Gazelle was split so that an equal amount was discharged on both sides. The net result was that the level of engine noise was reduced to the point where other sounds start to emerge, particularly that of the tail rotor.

How the big Westland helicopter will appear as a 46-seat transport.

It was of interest to note that when the company were working with an open intake an intense beam of compressor noise was projected forwards and downwards. When the intake was buried in a plenum chamber this noise was muffled.

The exhaust from the Gazelle was split into four outlets which were brought out to port and starboard and deflected downwards. The exhaust nozzles were encased in ejector shrouds to ventilate the engine compartment. "Prior to the first start-up," said the lecturer, "I imagined that the exhaust would present the most difficult development problem. I felt it might be dangerous and would in any case prevent the ground crew from approaching the helicopter when the turbine was running. To my amazement, a few minutes after the first start-up with the gas generator at idling r.p.m., the ground crew were walking within a few feet of the ejector nozzles, and the exhaust has since presented no problem. In actual fact, we have made no changes to the initial design.

"The problem of flame damping for night work seems to be non-existent and we do not expect trouble by reflection from the water during low-level operations. Moreover, there has been no contamination of cockpit or cabin."

In the first part of his paper Mr. Hollis Williams had mentioned the rotor brake as being one of the features which might need re-design with a free turbine. He now went on to explain that the static torque with the gas generator at idling speed was high, and that although the Wessex had quite a powerful brake it was found only just good enough to hold the rotor stationary. Efforts were made to stop the rotor with gas-generator idling, but this produced a tremendous amount of heat in the brake, with no particular effect on the rotor r.p.m. As attempts were made to increase brake capacity, there was cause for anxiety about the strength of the transmission and consequently it was decided to abandon the idea of stopping the rotor with turbine running.

A design-study of the brake necessary to stop the rotor under these conditions in a time deemed satisfactory by the user resulted in an excessively large and heavy installation, and one which would have introduced appreciable design-changes to the transmission.

The prime engine control was the fuel metering lever, which was operated through a throttle-harmonization linkage in a manner similar to that for the reciprocating engine. Some adjustment had to be made to the synchronizing cam because of the change in the throttle lever/power characteristics of the turbine. Despite the apparent simplicity of the control, some problems were expected to appear. At the start, there was trouble with compressor r.p.m. fluctuations, but this was found to be due to ingress of hot air from the engine oil cooler outlet. A small change to the outlet corrected it. Particular safeguards introduced by the engine maker to prevent a runaway of the free turbine (in case of an output-shaft fracture) could be inadvertently operated during certain throttle manipulations; this difficulty was quickly solved by the re-timing of these units.

A further problem was generally to obtain turbine power response of a similar nature to the piston engine. During a "quick stop" manœuvre of a helicopter, engine power was required to be rapidly reduced to a very low value and then increased rapidly to a full hovering value. It was found that, after shutting the throttle at the commencement of a "quick stop," some seven or eight seconds elapsed before full power could be restored. This was due to the accelerated control unit taking charge at low powers, to avoid compressor surges, and the solution was to provide a flight-idle stop set sufficiently high to avoid this possibility. Subsequently, this flight manœuvre was carried out with the necessary instrumentation to establish the position of this flight idle stop.

Showing graphs of recordings of throttle movement, torque response and the rotor r.p.m. against time, the lecturer said it was significant that, while there was no great increase in time for the manœuvre between the nominal ground idle power (10,500 c.r.p.m.) to power corresponding to 14,500 c.r.p.m., the drop in rotor r.p.m. was much less with the higher value of the compressor r.p.m. These tests were done with an adjustable flight-stop which was finalized at the higher c.r.p.m.

"Prior to first runs," continued Mr. Hollis Williams, "we

THE TURBINE HELICOPTER . . .

imagined that the power turbine would always be leaning up against the freewheel, and that some form of ground test equipment might have to be introduced to make sure that the freewheel was functioning. Tests proved this to be very nearly the case, as we have found under ground idling conditions that the freewheel needle can only just be split from the rotor needle."

In view of the position of the engine under the cockpit floor it was expected that a large amount of heat would be generated and would have to be dispersed. This was certainly the case at the start, but it yielded to normal treatment by increasing the flow of ventilating air and by insulating where necessary.

In general, the whole development had been quite rapid and apart from other advantages the turbine had justified itself on one outstanding point, that of the quick start. In the case of the piston engine the warm-up period took a very considerable time—something over ten minutes from cold. With the turbine this time was under a minute, apart from cockpit checks. In fact, with the pilot in his seat the helicopter had been demonstrated to become airborne in under 30 seconds from cold. The process was so quick that the planeguard helicopter for an aircraft carrier could now be contemplated as sitting at readiness on an outrigger platform, and not continually airborne during operations.

By using an American-built S-58 for the initial flight testing of the Gazelle, one year's development of the turbine installation had been carried out; and when the first Westland-built Wessex arrived on the flight line (as it would do very shortly) it would literally have a flying start, with the early experimental stage of the turbine left well in the background.

The Westminster. Westland entered into a licence agreement with Sikorsky for the S-56. This, the largest helicopter so far in the Sikorsky range, was initiated as a marine assault type, but had also been used by the U.S. Army. A considerable number of these large helicopters were now in squadron service with the U.S. Forces.

The S-56 was powered by two Pratt and Whitney R-2800 engines mounted in pods on a stub wing set in the high-wing position. The helicopter was designed for loading through front clamshell doors and loading ramps.

In the United Kingdom the only suitable engine that was available was the Napier Eland turbine. Fortunately this powerplant was already under development with a rear drive and it appeared that the best proposition would be to dispense with the stub wing and the engine nacelles and to mount the turbines on the cabin roof, forward of the main gearbox. The Westminster project was developed as a combined private venture effort between Westland and Napier.

"The Napier Eland," said the lecturer, "is a fixed-shaft turbine with which we had had no actual experience, and again we were making the problem more difficult by using a pair of fixed turbines driving on to a common rotor shaft. Fortunately Napier had under development a clutch which was also a fluid drive and we seized on this as a method of avoiding direct mechanical connection between the high-energy rotating parts of the two turbines, and in a similar way avoiding direct mechanical connection between the rotor head and the turbines."

The Westminster project, although based on an S-56 licence agreement, in actual fact made use of only part of the S-56; but the parts used nevertheless comprised some of the most difficult components, requiring the greatest amount of development work. Thus, the main rotor hub, the main rotor blades with the rotor shaft, tail rotor assembly, duplicated power controls and a number of other items were actual S-56 parts.

They had behind them a large amount of accumulated flight experience and, in fact, as a result of this experience numerous design changes had already been incorporated.

"At the start of the project," Mr. Hollis Williams continued, "there was no firm operational requirement, and we realized that we could spend a vast amount of engineering time and money producing a helicopter which, when complete, was not exactly what was required. We therefore decided to prove the turbines in association with the new parts of the transmission, by building in the first instance a flying test-rig, and our aim was to get our results in the cheapest and simplest possible manner. However, there is no such thing as cheapness or simplicity with a flying prototype of any description. Everything is relative, and we eventually decided that our flying test-rig had most of the elements for a successful crane, and should be so developed as a forerunner to the Westminster transport. This, therefore, is our immediate line of development. We intend by means of this rig, and by a second similar one which is now under construction, to build up flying hours and so accumulate the experience and background which will lead up to certification and good serviceability on the actual Westminster transport."

Turbine Control Problem. The Napier Eland turbine, said the lecturer, had a full-authority fuel governor and hence the main engine control was a speed selection lever. In the Westminster, each of the turbines was coupled into a single gearbox via a hydraulic clutch, a reduction gearbox and a freewheel. The importance of accurate speed selection of the two engines in order to prevent large asymmetry of power distribution had been indicated by a simple analysis and subsequently confirmed by a more elaborate dynamic investigation carried out on a digital computer. The slipping clutch (up to 2 per cent slip at maximum torque) was an important feature in the control of this coupled installation.

The engine control in the cockpit comprised two speed-selection levers with appropriate r.p.m. "gates"; at the top of each lever was a trimming knob so that fine adjustments can be made to the engine speed selector. Engine control has therefore been removed from the collective-pitch lever; the pilot had only to select constant-speeding r.p.m. In the event of failure of one turbine, the other turbine automatically developed full power without conscious action on the part of the pilot.

Installation. The engine installation was in general orthodox, but the rear drive turbines have fairly long high-speed drive-shafts and the mounting of turbines and gearbox on a flexible airframe introduced problems associated with shaft mal-alignment. The original toothed couplings on these shafts were replaced by specially designed ball couplings, and these were capable of standing a greater degree of mal-alignment; they were based on a similar coupling that was operating successfully in the Gazelle installation.

The high-speed shaft on each turbine was connected to the clutch, which was also the fluid drive, and then through the primary reduction gear, which incorporated the torquemeter, into the lower part of the main gearbox. The fluid drive introduced a heat-dissipation problem, and reacted on consumption; but the advantage of a non-mechanical link in the transmission would, they were confident, outweigh the disadvantages.

The lower part of the main gearbox, of Westland design, was connected to the upper part, which was Sikorsky designed and manufactured. This upper gearbox contained the final double epicyclic gear reduction, and the total gear reduction was 12,500 turbine r.p.m. down to 197 rotor r.p.m.

Summing up, the lecturer said: "Based on experience to date with one trial installation of a single turbine, I would say without hesitation that, in comparison with a piston engine installation of comparable power, development time and effort can be saved.

"The piston engine has been the mainstay of helicopter development up to this date, has given good service, and where first cost is an important consideration will compete with the turbine for some years to come, particularly in the smaller sizes where engine development continues. The turbine is the more sensitive to altitude combined with high ambient temperature. Where such conditions have to be met, as in a world-wide operational requirement, an oversize turbine must be installed, probably run in a gated condition at sea level I.S.A. This tends to increase first cost and the gating reacts unfavourably on consumption.

"However, taking the all-round view, I am sure that the many advantages of turbine power outweigh the few disadvantages, and that better helicopters will result from its use."

R.O.C. GOES UNDERGROUND

SO that the Royal Observer Corps can fulfil the twin rôle of tracking enemy aircraft and plotting nuclear fall-out, its posts are being equipped with measuring instruments and underground reporting stations. A post which already has this equipment—"November 1," two miles north of Farnham in Surrey and overlooking Farnborough airfield—was shown to the Press recently and A. Cdre. J. H. T. Simpson, Commandant of the R.O.C., and Mr. R. H. F. Firth of the Home Office were there to answer questions.

The instruments are a ground zero indicator, which gives a bearing and azimuth, so that by the intersection of these from two or more posts a position can be plotted by triangulation at the control centre; a bomb power indicator, which measures vibrations and thus indicates the height of a bomb-burst; and a gamma radiation detector, readings from which can be taken underground in a reporting post 15ft below the surface. There is room in the latter for up to four observers, who have sleeping accommodation and an 8-10 hr supply of air.

The R.O.C. is now holding its biggest annual summer camp since 1948—at R.A.F. West Malling, with which the Corps was closely associated during the war. Between June 23 and July 26 some 3,000 men and women volunteer observers will have attended. The R.O.C. is now some 15,000 strong, but with its new responsibilities still more members are needed.

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CIVIL AVIATION

A DC-8 OF 310,000 lb

SINCE 1955, when the DC-8 and Boeing 707 jet transports were first announced and ordered, the weights of these aircraft have crept up; but they have not—as widely predicted by the runway gloom-mongers—actually exceeded 300,000 lb.

Inevitably this has now happened; a new version of the DC-8, for "extended-range intercontinental" operations, and with a take-off weight of 310,000 lb, has been announced by Douglas. Several DC-8 operators, un-named, have switched some of their orders to this new version.

The new DC-8 is stated to be capable of carrying a 26,500 lb payload for a range (with "normal" fuel reserves) of 5,600 miles. An additional 1,692 U.S. gal of fuel is carried compared with standard intercontinental DC-8s which have a maximum fuel capacity of 21,615 U.S. gal, and a take-off gross weight of 287,500 lb. This standard version will carry the same payload as the new model (26,500 lb) for 5,000 miles with the same reserves.

It thus appears that the increased range of the new version—600 miles—is curiously small in relation to the considerable weight increase, which amounts to 22,500 lb. This is presumably accounted for by increased structure weight; and it is noteworthy that the maximum landing weight of the new DC-8 model is 199,500 lb, compared with 194,000 lb of the standard models. Douglas say that the new DC-8 can be powered by either Pratt and Whitney J75s or Rolls-Royce Conways.

All models of the DC-8, including the 265,000 lb domestic version (J57s), now on flight test, have identical dimensions. For the record, max. take-off weight of the intercontinental Boeing 707 (-320 and -420) is 295,000 lb, while the domestic (-120) model weighs 248,000 lb.

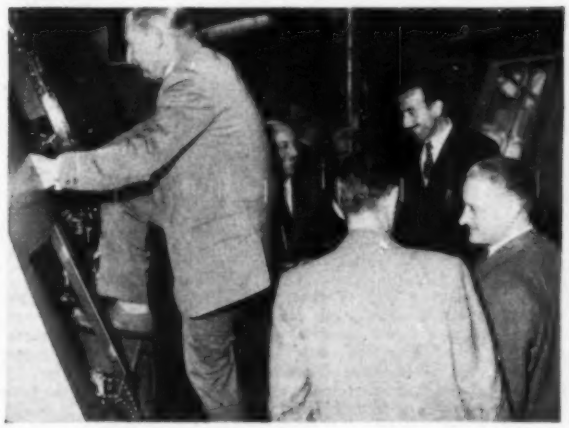
No details are as yet available of the increased field length which must inevitably be required by the heavier DC-8. The new U.S. climb requirements have already increased the take-off field length needs of the intercontinental big jets beyond the 9,000ft-10,000ft originally quoted for standard conditions. Now an even heavier DC-8 variant has been added, and it looks as though some airport planners will have to think afresh again.

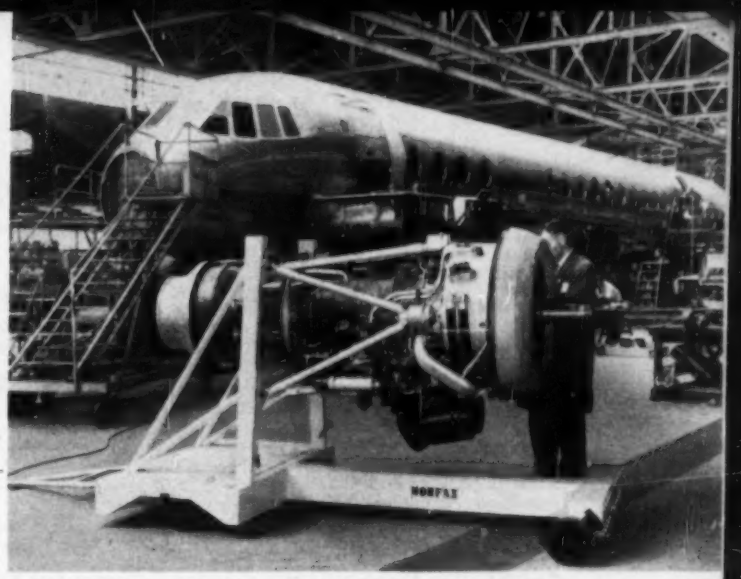
PERTINENT PARLIAMENTARY QUESTIONS

THREE important air transport matters, upon which, in recent months, *Flight* has frequently urged action, were raised in the House of Commons on June 18. They concerned (1) the jet *v.* propeller fare-differential, (2) rearward-facing seats, and (3) the future of private flying around London when Croydon is closed.

The Minister of Transport and Civil Aviation, Mr. Harold Watkinson, was asked by Mr. Gresham Cooke (Con., Twickenham) "Whether he has now received an application from B.O.A.C. for his approval to air fares being charged on a differential basis as between jet and propeller-driven aeroplanes . . ." The Minister said that no such application had been received from B.O.A.C., but that "My advisers are urgently examining this whole matter . . . I think that this is a subject which should be thoroughly examined, because it is bound to be raised at the I.A.T.A. Conference later this year, and this is what my department is now doing."

Mr. Frank Beswick (Lab., Uxbridge) asked if the Minister would state "The evidence supporting the claim that there is no significant addition to the safety of air passengers seated in rearward-facing seats, and on which he bases his decision not to make such seats mandatory in new British aircraft." The Ministerial reply was to the effect that evidence was "not conclusive,"





From Weybridge comes this picture of the first Vickers Vanguard, due to fly next November. A Tyne powerplant is seen in the foreground. Rolls-Royce are converting two ex-B.E.A. Elizabethans to Tyne power: the first, G-ALZR, is due to start development flying soon; the second, G-AKRD, will be used by B.E.A. on simulated airline services to amass 2,000 engine hours—a programme due to start next December and to last for ten months. The aim is to complete 10,000 Tyne hours before Vanguard services begin in 1960.

but that a small working group had been set up "to review this complex question." Mr. Beswick's comment was that this was "most unsatisfactory"; the Government was unable to give any evidence controverting the view—voiced by the A.R.B. and implemented by the R.A.F.—that rearward-facing seats were much safer. The Minister, he thought, should be doing something about it.

The third question, concerning facilities in the London area for private civil flying when Croydon is closed, was asked by Mr. J. A. Leavey (Con., Heywood and Royton). Mr. Airey Neave, Joint Parliamentary Secretary to the M.T.C.A., replied that, south of the Thames, Gatwick would be available to private aircraft equipped with suitable radio but not to club aircraft. Facilities at Biggin Hill for private pilots—including flying clubs—"are being examined in conjunction with the Secretary of State for Air." Asked when Croydon would close and if all-weather facilities at Biggin Hill would include radio, Mr. Neave said: "The question of all-weather facilities is under consideration at the moment . . . To minimize inconvenience to users of Croydon, it is expected that the airport will remain open until the latter part of 1958."

Thus, in one important respect, business aircraft pilots will be better off than had been expected. In Gatwick they will have a Customs airport with good access to London—though with a runway that could become unusable in a strong crosswind. But if Biggin Hill is developed as a replacement airport for Croydon, there are going to be some difficult decisions to make. The companies which support Croydon's aircraft had largely made up their minds to move to Biggin if that airfield were to be developed for private flying. But with Gatwick available to business aircraft and to private owners, many firms may decide that better opportunities await them there.

A further Parliamentary question related to the disposal of B.O.A.C.'s DC-7Cs, a matter raised in an editorial of this journal on March 14 [B.O.A.C. gave the Government an "express undertaking" in 1955 that DC-7Cs would be disposed of when Britannias were in Atlantic service]. Mr. Watkinson said that the future of B.O.A.C.'s DC-7Cs was "still being considered." This was not, he said, a question of replacing them with British aircraft.

ROLLS-ROYCE IN SOUTH AMERICA

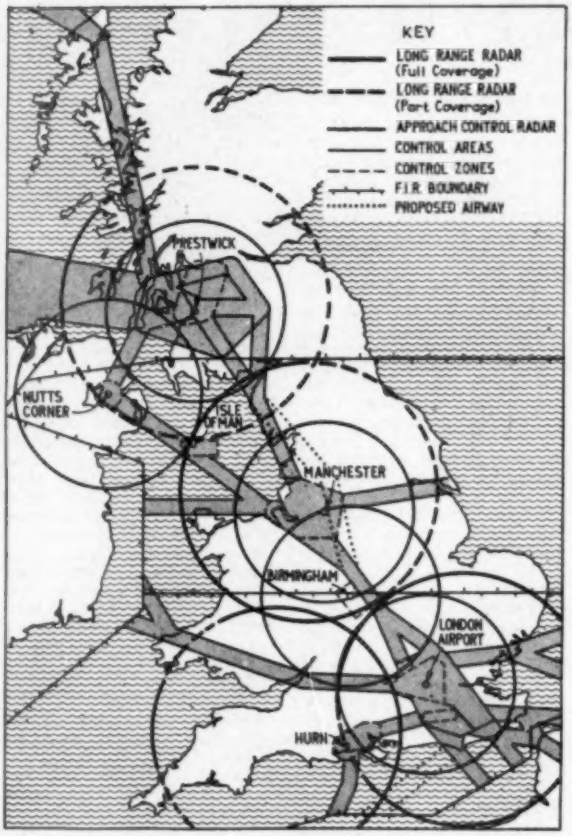
OVERHAUL and spares facilities are being set up by Rolls-Royce in Brazil, probably in the Sao Paulo area. On the basis of present firm orders, there will be nearly 150 Rolls-Royce aero engines in service in South America by 1960. The new facilities will provide complete overhaul and spares service, and will include testbeds. Initially the base will serve the Brazilian Viscount (Dart) operator V.A.S.P., and also VARIG who have ordered Caravelles (Avon RA.29) and Boeing 707-420s (Conway).

Firm orders already placed for Rolls-Royce turboprop and turbojet engines for South American operation are as follows:

Seen during a visit of British independent airlines to Air Trainers Link, Ltd., on June 17, are Capts. G. W. Harding and D. A. Woolfe of Airwork, and Mr. W. Brynack of B.A.S. They are inspecting, with their hosts, the AT100/500 general-purpose trainer.

CIVIL AVIATION . . .

This month the Minister of Transport and Civil Aviation authorized a five-year, £5m "over-all top priority" plan to provide radar surveillance of all U.K. airways. Shown here are the locations of the four long-range radars, from which information will be relayed to three joint civil/military A.T.C. centres in London, Central England and Scotland. The Centres are to be rebuilt, and radar information displayed on P.P.I.s is eventually to be replaced by air data computers linked to clutter-free height and aircraft identity displays.



V.A.S.P. (Brazil), five Vickers Viscounts (Darts) ordered; VARIG (Brazil), two Sud-Aviation Caravelles (Avons) ordered; three Boeing 707-420s (Conways) ordered; L.A.V. (Venezuela), three Viscounts (Darts) in service; six Fairchild F-27s (Darts) ordered; AVENSA (Venezuela), five Fairchild F-27 (Darts) ordered; P.L.U.N.A. (Uruguay), three Viscounts (Darts) ordered; Aerolineas Argentinas (Argentine), six de Havilland Comet 4s (Avons) ordered.

B.E.A.'s INNER CIRCLE

HOWEVER advantageous London's two-airport system may be in relieving the pressure of peak-period runway traffic, new problems of inter-airport travel will arise as Gatwick's work load increases. B.E.A. have already expressed their intention of operating more international services from Gatwick, and as they do so the difficulties of making connections will become more acute. Although the two airports are only about 25 miles apart, few travellers will have the means available to travel direct from London to Gatwick by road. The only alternative to travelling into and out of central London is a cross-country journey in an airport bus, and development of Southend as a third airport in the London system would raise further problems of ground travel. It is in just such a communication situation that New York Airways operate services between Idlewild, La Guardia and Newark, and Chicago Helicopter Airways between Midway, O'Hara and Meigs Field heliport in downtown Chicago. B.E.A., with an obvious eye to helicopter or S.T.O.L. services, have recently received from the A.T.A.C. permission to operate an "inner circle" of services between London and Gatwick and ultimately to Southend. Special air traffic control routeings, direct between the airports but clear of normal traffic patterns, are proposed for fixed-wing aircraft. Writing in the B.E.A. magazine, Lord Douglas suggests that "if special routeings prove to be impractical with aeroplanes, there seems to be good prospects that helicopters may ultimately perform a useful job in this sphere."

NORTHEAST CANCEL THEIR BRITANNIAS

THE cancellation of Northeast's order for five Britannia 305s is now confirmed by the American airline, who hope to recover $357,000 of their $456,501 advance payments. Bristol Aircraft said last week that they had heard nothing from Northeast officially.

Though the cancellation was not unexpected (*Flight*, June 6), it is nonetheless a bitter blow to Bristol and Shorts, who have paid dearly for failure to deliver on time last autumn. Northeast say that they have cancelled their Britannias because they have been unable to obtain satisfactory financing: in the same breath, however, they refer to their interest in the Viscount and say that they "must have jets" by the autumn of 1959 or 1960. This suggests that Northeast's cancellation has been prompted by competitive considerations as well as by financial difficulties. Northeast must have carefully weighed up their competitive situation six months hence, when Eastern will have Electras on the rich, 1,100-mile New York - Miami route; perhaps the Viscount—on the assumption that some could be acquired quickly—is being considered to meet this immediate competition.

It now remains to be seen how soon the five surplus Britannia 305s can be sold. One is at present sales-touring Latin America (in Cubana colours), and all the 305s are, of course, available for very early delivery. Curiously, nothing more has been heard of B.O.A.C.'s offer—made last September when Northeast's order was postponed—to take the 305s over. The obvious course now is for B.O.A.C. to implement this offer, disposing of some DC-7C capacity (see page 905: "Pertinent Parliamentary Questions").

With continued growth in Southend Airport's traffic—passengers handled increased by 63.5 per cent last year, 90 per cent the year before—approach and runway lighting has been progressively improved. The photograph shows new G.E.C. bi-directional high-intensity (35,000 candelas) runway lights remotely controlled by G.E.C. Multiplex transmitter and receiver equipment. This is the first installation of its kind on any British civil airport.

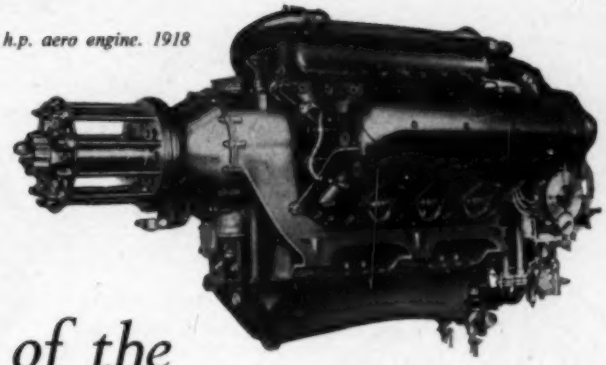
ROUBLE TROUBLE

GROWTH of business and tourist traffic between Russia and the West has made it increasingly clear that, at least as far as visitors are concerned, the rouble is grossly over-valued in relation to Western currencies. An article in the current *Bulletin* of the Oxford Institute of Statistics demonstrates that the consumer's rouble is worth about sixpence, the effective exchange rate being 35 roubles to the pound as against the official rate of 11.2 roubles. Thus tourists pay nearly two bob for a tanner's-worth of roubles.

To overcome this unbalance, a special tourist rate has now been introduced at a level about 150 per cent above the present rate—equivalent to 27.6 roubles to the pound. At this new rate foreign visitors will find that their money goes almost as far as it does at home: many manufactured goods will be found to be cheaper, while food (with the exception of bread) will be expensive.

While reducing the costs of a sojourn in Russia, this semi-

Napier Lion 450 h.p. aero engine. 1918



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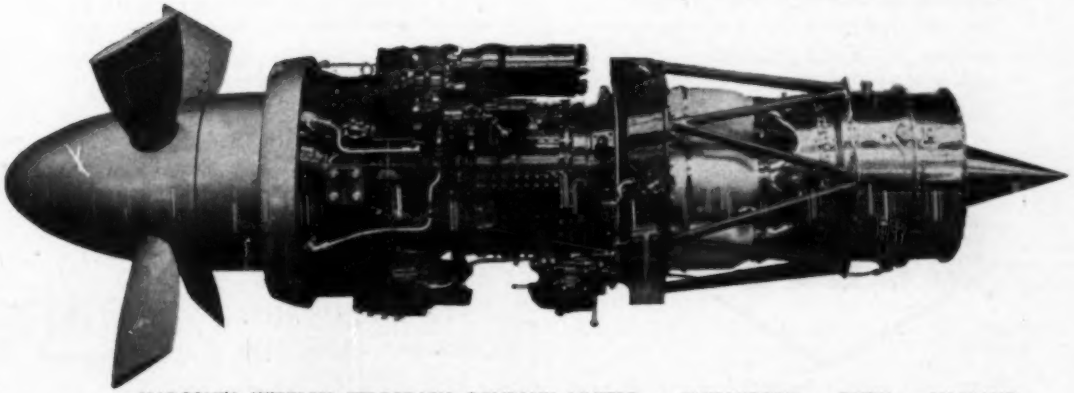

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Side-by-side, participating in a British Commonwealth occasion, are seen the representative commercial jet airliners of America and Russia—the Boeing 707 and Tu-104. They were at Vancouver on June 15 on the occasion of the British Columbia Centennial Aviation Show.

CIVIL AVIATION . . .

devaluation will not affect the price paid by Westerners for air fares to the U.S.S.R. Fares paid by Russians coming to Western Europe are to be increased sharply, however—that from Moscow to London rising from 1,600 to 4,200 roubles.

A curious potential anomaly is that fares within the U.S.S.R. and to other Iron Curtain countries will remain unchanged. This could mean that Russians flying to Western Europe will find it cheaper to break their journey ticket-wise at Prague or Budapest (in the same way that Manchester businessmen have until recently been breaking their journeys to London at Birmingham, thus saving two guineas on the nine-guinea return fare). The governmental character of Russian air traffic will militate against widespread resort to such "capitalist intrigues" and will also prevent a repetition of that sad condition being experienced in the U.S., whereby traffic volume falls in response to a fare increase.

The Dutch and Soviet Governments have seized this appropriate moment to conclude an air agreement providing for an Amsterdam - Moscow service. Starting on July 21, K.L.M. DC-6Bs and Aeroflot Tu-104s will each offer a once-weekly service, K.L.M. flying *via* Warsaw and the Russians operating non-stop.

Expecting further increases in air traffic, Marshal Zhigarev is already negotiating in Paris for a direct service between the French and Russian capitals, and he is shortly expected to open discussions with the West German Government for a Moscow - Frankfurt service.

REPORTING TO THE PUBLIC

THERE are few basic industries in the world in which members of the general public are so interested as in air transport. Not only is this a reflection on the glamour of flying to strange places abroad, but also a result of the amount of public money that has been poured into the provision of air services. For these reasons it is appropriate that airlines should seek to give the public as full a picture as possible of their activities. No media are better suited to this end than the annual report and the airline timetable.

The two British corporations have an unequalled record in respect of their annual reports. But the publication by B.O.A.C. last year of a "popular" shortened version of their accounts suggests that insufficient attention has in the past been paid to presentation. The Japanese belief that even the finest food will suffer from a poor setting is apparently well understood by K.L.M., for their latest accounts are a good example. The content provides not only a comprehensive picture of the airline's activities, but also gives details of an unusually frank nature (obsolescence policy, long-term debt, capital commitments). Even more significant is the attitude that appears to pervade every page of this report: that air transport is a business in which K.L.M.'s main aim is to make a profit.

The Dutch airline has also scored a hit with its latest timetable. The floppy pamphlet of the past has been replaced by a firm, magazine-style, pocket-sized, indexed booklet. The new format resulted from two years' study by K.L.M.'s schedule-planning division. Both prospective travellers and travel agents will certainly be influenced by this publication's ease of reference and attractive appearance.

WHO FLIES IN EUROPE

A YEAR or two ago B.E.A. initiated a comprehensive investigation into the characteristics of the British flying (and non-flying) public. That survey, carried out by Market Information Services, Ltd. (a subsidiary of Colman, Prentis and Varley—B.E.A.'s advertising agents) was based on the information provided by representative sections of London and Birmingham society. A keynote was the distinction between various social classes in such matters as attitudes to flying, holiday habits, and expenditure on holidays. Possibly the most significant finding was the number of people who can afford to fly, yet continue to use surface transport. A surprising feature was the large number who have no intention of flying.

B.E.A. has deservedly acquired a good reputation for keeping the public in the picture; and in the case of this survey a wide audience, including travel agents and professional market researchers, has been informed of the findings. Unfortunately, the same cannot yet be said of the comprehensive survey recently carried out on cross-Channel traffic last summer between Britain and France. This review was sponsored by the British Travel and Holidays Association and the French Government Tourist Office, and covered the traffic carried by the nationalized cross-Channel shipping services and by Air France, B.E.A., Silver City and Skyways. Conflicting interests of the participants—a factor absent from B.E.A.'s own enquiry—is probably the factor preventing a more complete dissemination of data, only the most general details being given in the summary published recently by the B.T.H.A.

Traffic carried in the period covered by the survey, the third quarter of 1957, corresponds to 50 per cent of the year's total. As traffic between France and Britain accounts for almost one-half of passenger movement between Britain and the Continent, and one-third of all traffic in and out of Britain (on a passenger-mile basis these proportions would, of course, be considerably lower), the survey merits close examination. Total U.K. - France traffic last year was estimated at 3m passengers and almost ¼m cars, air services being estimated to account for about one-third of the passengers and one-sixth of the cars. Of the 500,000 British and 100,000 French travellers on this route, 1,500 and 750 were interviewed respectively.

Taking each group separately, the British travellers displayed fairly clear characteristics: they were primarily on pleasure bent (89 per cent of total); they usually planned to stay in France (46 per cent in that country alone, 38 per cent in France together with other countries); they would be abroad for an average stay of 16 days; they were primarily (76 per cent) "non-manual" by profession; they were regular visitors to the Continent, rather more than half having been there three times before, with the balance split evenly between newcomers and old-timers with at least six visits to their credit; they tended to arrange their own travel, although the number of "inclusive tourists," at present only numbering one in four, is growing at an even more rapid rate; and they spent about £50 per person on their holiday (inclusive-tourists averaged £65, others £44, the high figure for inclusive tourists reflecting the fact that they tend to travel farther abroad).

The French group followed a rather different pattern. Students(?) appeared to account for 60 per cent of travellers (against less than one per cent for the Britons). Two-thirds were under 24 years of age, and nearly one-third gave family incomes over Fr.2m (only 12 per cent of the British group gave family income to be over the roughly equivalent figure of £2,000), and two-thirds were only on their first or second visit. Over one-third gave improvement of their English as a reason for travelling. Expenditure averaged Fr. 37,000 over a period of four weeks, a daily average of about Fr. 1,400 as against £3 for the British group.

Visitors to Shorts, Belfast, on June 17, where they inspected Britannia and Canberra production, and the SC.1 VTOL research aircraft, were B.E.A.'s chairman and his wife, Lord and Lady Douglas. They are seen here with Capt. St. J. Fancourt of Shorts (left), and Mr. R. E. Harvey, the company's general manager and joint deputy managing director.

CIVIL AVIATION . . .

BREVITIES

THE number of passengers handled at all airports in the U.K. and Channel Islands in March 1958 was only 1 per cent greater than in March 1957. Total traffic at London airport rose by 2 per cent, while total traffic at other airports fell 2 per cent. Channel Island traffic was unchanged. (For fall in U.S. traffic, see leading article in this issue.)

* * *

A Convair 440 belonging to Cruzeiro do Sul crashed at Curitiba between Porto Alegre and Rio de Janeiro on June 17. There were ten survivors among the 27 people on board.

* * *

B.O.A.C.'s Boeing 707s are to be fitted with inflatable escape slides manufactured in the U.K. by Palmer Aero Products, Ltd., under licence to the Garrett Corp.

* * *

Air Ceylon are planning to increase frequencies on their Singapore - Ceylon - Amsterdam service to two a week later this year. The possibility of replacing their L.749s (chartered from K.L.M.) with Super Constellations is also being considered.

* * *

Mr. J. R. Adams, Q.C., has been appointed chairman of the public inquiry into the accident to a B.E.A. Viscount at Nutts Corner on October 23, 1957. The assessors are S/L. B. J. L. Greenland (R.A.E.) and Capt. S. B. Beevers (Eagle Aviation). The inquiry will commence on July 8.

* * *

The demonstration Fokker Friendship at present in Brazil may be flown to Australia in September to commemorate the 30th anniversary of Sir Charles Kingsford-Smith's flight in a Fokker F.VIIb-3m from Australia to New Zealand in 1928. On September 11 T.E.A.L. will operate a commemorative trans-Tasman flight carrying a V.I.P. party and letters with special cover and stamps.

Unexpectedly low traffic has caused T.W.A. to announce an employment cut of 1,000. Total staff is 19,900.

* * *

Thruxton Airfield is to be sold by public auction on July 7, permission having been given by the planning authorities to its continuation as an airport.

* * *

K.L.M.'s polar service from Amsterdam to Tokyo and Biak will commence on November 1. The DC-7Cs will require two transit stops westbound and one eastbound.

* * *

Continental Air Lines' shareholders have approved an increase in the airline's ordinary share capital from $1.5m to $5m. This will facilitate the raising of bank credit or issue of debentures.

* * *

After their 100-day strike, Western Air Lines have now resumed full services. The company have provided complete refresher courses to all pilots and engineers. During the strike, one DC-6B, six Convair 240s and three DC-3s were sold to Braniff, Lockheed and Air France respectively.

* * *

Speaking at the opening of the tenth conference of Western European airport authorities (at which 14 airports were represented), Mr. Harold Watkinson, Minister of Transport and Civil Aviation, said that "noise, tighter control of rapidly shrinking airspace, and the speeding of the air traveller on the ground" are some of the major problems at present being tackled in this country.

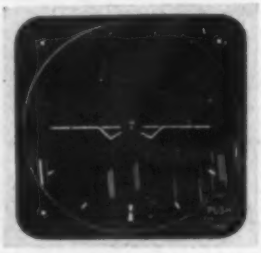
* * *

Mr. R. M. Ansett, chairman of Ansett-A.N.A. and of Butler Air Transport, is at present visiting Handley Page to discuss the Dart Herald. Airline officials from MacRobertson-Miller Airlines, N.Z.N.A.C., W.A.A.C., I.A.C., L.A.V., B.E.A., Derby, Silver City, Hunting-Clan and Jersey Airlines, and representatives from British Honduras, Iran and Thailand, are also among recent visitors to talk about the Dart Herald.

CLUB AND GLIDING NEWS

THE Leinster Aero Club will be holding their fourth annual air display on Saturday and Sunday of this weekend, at Weston Airfield, County Kildare. It had been hoped to invite the U.S.A.F. "Skyblazers" aerobatic team to participate and, possibly, "Treble One" Squadron, R.A.F., but unfortunately the Irish Government has vetoed the proposal. The reasons given are that, first, the Republic of Ireland is not a member of NATO, and that Ireland's "neutrality" would therefore be jeopardized; second, that Weston, being a grass field of relatively small dimensions, does not possess emergency landing facilities for jet aircraft. These arguments (writes a correspondent) do not seem particularly logical in view of the very successful aerobatic displays given by the jet aircraft of NATO countries in Switzerland, not herself a NATO member. Also the Irish Air Corps base at Baldonnel, adjacent to Weston, is an operational jet field with paved runways, as well as being a diversionary airfield when Dublin Airport is closed. The Government ban even extends to the participation of the Air Corps' Vampire T.55s in the Weston display.

THE Sperry Gyroscope Company have announced a new miniature stand-by artificial horizon, the H.L.9, specially designed for gliders and sailplanes. It is an A.C. instrument having its own static inverter which provides 60 volt, 400 c/s single-phase A.C. power from 24-volt batteries. The instrument weighs 4 lb 7 oz and the inverter 1 lb 15 oz. A feature of the new horizon is its low current consumption: approximately 0.3 amp at 24 volts during normal running. Slightly more than 1 amp is required for starting, and run-up occupies 2½ min; an economy switch is fitted which reduces the current required to the economy running level after this time. If the economy switch is not used, the power consumption is 0.55 amp. When the gyro is started with the switch in the economy position, the run-up to synchronous speed will occupy about 15 minutes.



Sperry H.L.9 horizon.

Presentation is on a standard 3¼in-diameter bezel with a moving horizon bar against a black background and a gull-winged model attached to the glass. The sensitivity of the horizon bar in pitch is said to be of the same order as larger instruments over the first 15 deg of bank. A mechanical caging control is provided but the instrument is self-erecting even if switched on in continuous turns. Pilots who have used the H.L.9 report that there is no noticeable turning error.

MOST original reason for the refusal of a gliding site, as given recently to the Hertfordshire Gliding Club, came from the Metropolitan Water Board, who feared that a glider might land and "block the Board's new river." The club's current newsletter lists 11 aerodrome sites which have been examined, and 26 individuals and authorities who have been contacted, in its search for somewhere to begin gliding operations. Further suggestions for a site would doubtless be welcomed by the secretary, Mr. D. J. Muir, 146 Boundary Lane, Welwyn Garden City, Herts.

THE Polish magazine *Skrmydlata Polska* reports that a new Polish light two-seater, the PZL-102 Kos (Blackbird) has made several successful flights. It is powered by a WN-1 flat-four air-cooled power unit of 65 h.p. enclosed by alligator cowlings that split along the crankshaft centreline and are hinged on the engine firewall. Conventional in appearance, the PZL-102 is a low-wing monoplane with a fixed undercarriage and tailwheel. It is chiefly distinguished by a large bubble canopy sliding along a central spine on the rear fuselage. Dual controls are fitted.

A SURE way of increasing output is to set a production target —and this applies just as much to monthly flying times as it does to manufacturing aeroplanes. Wolverhampton Aero Club are among the clubs that are doing this and so are the Lancashire Aero Club, who have published month by month target totals amounting to 2,000 hr flying in the next twelve months. The targets range from 300 hr in August to 40 hr in December. The latter club, incidentally, have recently published the first in a new series of *The Elevator* magazine—of unusually high standard among club publications.

FOLLOWING the R.A.F.A. Display at Exeter Airport tomorrow, June 28 (Service participation in which was noted in our last week's issue), Exeter Aero Club is holding a dance, which—with a bar open from 10.30 a.m. to 11.30 p.m.—promises to be "informal but gay." Civil aircraft items in the display programme will be contributed by the Tiger Club and Plymouth Aero Club, the latter providing Tiger Moths for the parachute jumping.

SERVICE AVIATION

Royal Air Force and Naval Flying News

The Scimitar foursome which put on an outstanding show at Ford's final Naval air day.

FORD'S SWAN-SONG

AMONG stations shortly to be closed down is R.N.A.S. Ford (Captain A. H. Abrams, D.S.C., R.N.), so the annual air day held at this pleasantly situated Sussex airfield on Saturday was its last. More was the pity, therefore, that bad weather marred the proceedings. With typical perversity, a heavy storm-cloud approached soon after flying began, disgorged itself during the principal events, and drifted away just as the programme ended.

Though it sent all but the keenest spectators scuttling for the hangers which housed the excellent static show, it made little apparent difference to the flying, but the pilots, particularly those of the high-speed aircraft, had an exceedingly tricky task. Yet with perfect discipline they fitted themselves into what was almost a split-second schedule, and the whole programme of twenty events was run through without a hitch in the advertised hour and fifty-five minutes.

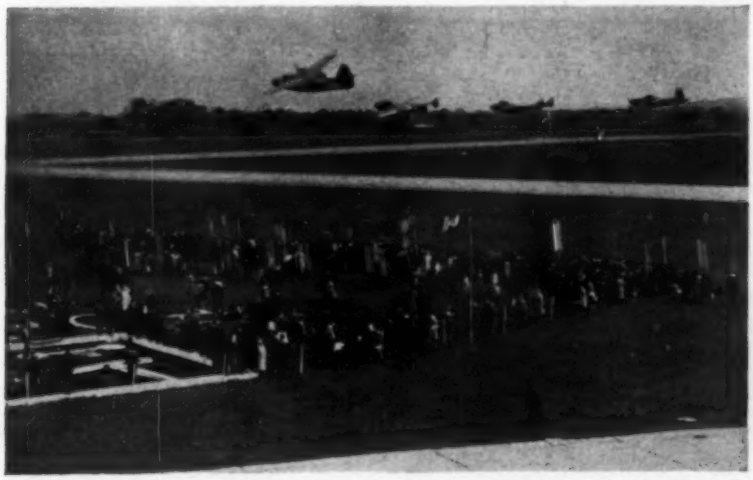
High-spot of the afternoon was unquestionably the appearance of four Scimitars, two from No. 803 Sqn., soon to be operational in H.M.S. *Victorious*, and two from No. 700, the Trials Squadron at Ford. After a series of take-offs that set the keynote, with each big aircraft blasting great sheets of spray from the streaming wet runway, the quartet proceeded to perform some impressive evolutions in the tightest of box formations. One pilot then broke away for an independent demonstration, which began with a low pass at perhaps 600 kt, shock-waves flickering round the aircraft in the best Farnborough Show tradition. Most impressive was an upward roll to a cloud-base that fortunately remained reasonably high throughout the proceedings. The four pilots were Lt-Cdr. Lamb (leader), Lt-Cdr. Leece (the solo performer) and Lts. Anson and Middleton.

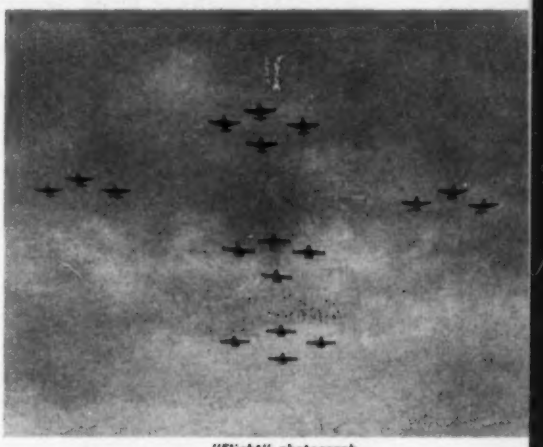
At some risk of seeming to make invidious comparisons, four other items may be singled out for mention here. There was a fine history-book contribution by a trio of vintage aircraft: the venerable Swordfish, flown by Cdr. Thompson, the Commander (Air) at Lee-on-Solent; Fulmar G-AIBE, piloted (though scarcely at F.D.2 speed) by Peter Twiss; and the Spitfire, with which Jeffrey Quill gave an aerobatic demonstration that was a model of what such performances should be. Lt. Conklin, a U.S. Navy officer on attachment, performed Sea Hawk aerobatics in the tradition established by that master of the art, the late Lt-Cdr. D. P. W. Kelly. Lt-Cdr. Brett-Knowles, Lee-on-Solent's met. officer, gave as pretty a display of sailplane aerobatics in a Slingsby Prefect as we have ever seen, ending with a dive to the deck and, startlingly, a tight loop straight off it. Four Sea Hawks of No. 804 Sqn., led by the squadron C.O., Lt-Cdr. Perkins, went through an elaborate aerobatic routine with the unanimity of a single aeroplane.

Visiting aircraft demonstrated included a Sea Vixen, handled with verve by D.H. test pilot Chris Capper, who did a carrier touch-and-go on the runway at the height of the rainstorm; and a Folland Gnat, nimble and pretty as ever in the hands of Mike Oliver.

A variety of jet-propelled witches and other curious manifestations suspended from Dragonflies and Whirlwinds provided light relief at various points in the programme.

A section of the Ford crowd watches a demonstration by instructors of the Junior Officers' Air Course with a Sea Prince, Sea Vampire T.22s and Sea Balliol T.21s.
"Flight" photograph





"Flight" photograph

Ford formation: Sea Hawks and Sea Venoms.

Royal Visit

ALL three types of V-bomber—Valiant, Vulcan and Victor—were due to be inspected by the Duke of Edinburgh during a visit to R.A.F. station Wyton last Tuesday. From there His Royal Highness was going by helicopter to the Central Reconnaissance Establishment at Brampton, then returning for a flight in a Vulcan.

Tangmere Farewell

AT a ceremony at R.A.F. Tangmere last Monday, attended by the A.O.C-in-C. Fighter Command, Air Chief Marshal Sir Thomas Pike, the last operational fighter squadrons to be based at the station—No. 1 (equipped with Hunter 5s) and No. 25 (Meteor N.F. 12 and 14s)—handed over their Standards to Nos. 263 and 153 Sqns. respectively. These two squadrons, based at Stradishall and Waterbeach, will at a later date assume the numbers 1 and 25. No. 263 Sqn. is equipped with Hunter 6s, and No. 153 with Meteor N.F. 12s and 14s. The future of Tangmere is not yet decided, but Sir Thomas stated that it was no longer suitable, because of its location, to form part of the defence of the United Kingdom.

No. 1 Sqn. Posted Home

LINCOLNS of No. 1 Sqn., R.A.A.F., are to make their last operational flight against Malayan terrorists on July 2 and the squadron is due to be back in Australia on July 17—eight years to the day since it arrived in Malaya, where it has been based at Tengah on Singapore Island. It will be replaced in Malaya by No. 2 Sqn., R.A.A.F., equipped with Canberras, which is to be based at Butterworth, an all-Australian station commanded by A. Cdre. K. R. Parsons (*Flight*, June 6).

No. 1 Sqn. was the first Commonwealth

SERVICE AVIATION . . .

squadron to go into action—at Suez on June 12, 1916—as part of the newly formed Australian Flying Corps. One of its members, Capt. (now A.V-M.) F. H. McNamara, was awarded the V.C. in the First World War for landing under gunfire to pick up a crashed and wounded pilot—this feat being commemorated on the squadron badge by a diving kookaburra bird. No. 1 Sqn. began its long association with Malaya in 1940, when on its first sojourn there it operated against the Japanese.

M.E. Awards

AWARDS to four R.A.F. officers for their part in Middle East operations have recently been announced.

S/L. C. I. Blyth, who won the D.F.C. on operations in Korea in 1952, has been awarded a Bar to it "for gallantry and devotion to duty in air operations in Aden and Oman"; F/L. P. H. T. Clay, who won the D.F.C. in 1945, receives a Bar for his part in Aden air operations; and F/L.s G. A. Etches and T. Simpson have both been awarded D.F.C.s for gallantry and devotion to duty in Aden.

Birthday Honours

NAMES of Air Forces recipients of Queen's Birthday honours and awards were published on this page last week, and the list is continued and completed below:—

Royal Red Cross (Second Class): Sq/O. I. M. Turner, Princess Mary's R.A.F. Nursing Service; Flt/O. R. Massam, Princess Mary's R.A.F. Nursing Service.

A.F.M.: F/Sgt. L. E. Adlington; F/Sgt. D. A. Brew; F/Sgt. W. A. Copley; F/Sgt. R. T. Emeny; F/Sgt. C. W. G. Lusty; F/Sgt. J. E. Miller.

B.E.M. (Mil.): F/Sgt. T. L. Brown; F/Sgt. D. S. Cooke; F/Sgt. S. G. Cucksey; F/Sgt. F. T. Edwards; F/Sgt. D. E. Foster; F/Sgt. D. C. George; F/Sgt. R. F. Glover; F/Sgt. F. M. Holmes; F/Sgt. W. Holmes; F/Sgt. A. Kirman; F/Sgt. R. Pryse; F/Sgt. B. H. Roberts; F/Sgt. O. St. J. Roberts; F/Sgt. J. A. Rossiter; F/Sgt. W. G. N. Sanders; F/Sgt. F. J. Wakeham; F/Sgt. F. Wappat; C/Tech. N. Barnes; C/Tech. J. Mills; C/Tech. L. V. St. Ruth; C/Tech. R. Samuel; C/Tech. C. J. D. Schofield; C/Tech. H. R. Weeks; Acting F/Sgt. W. B. Badley; Acting F/Sgt. J. R. O'Brien; Acting F/Sgt. J. G. Petrie; Acting F/Sgt. K. W. Shonk; Acting F/Sgt. R. S. Thomas; Sgt. J. M. Brame, W.R.A.F.; Sgt. R. Buston; Sgt. J. R. Eddershaw; Sgt. S. E. J. Gorringe; Sgt. A. V. Hamer; Sgt. J. L. Hayward; Sgt. J. Higginbotham; Sgt. J. F. McLean; Sgt. F. B. Norman, Sgt. J. G. Shenton; Sgt. B. F. Stinson; Sgt. L. W. Tarr, R.N.Z.A.F.; Acting Sgt. J. R. Dennis; Acting Sgt. M. J. Johnson; Cpl. E. C. Walter; Cpl. F. S. Williams; Acting Cpl. A. J. Davies; S.A/C. J. McGuire.

Queen's Commendations for Valuable Services in the Air: W/C. D. B. Gericke; Acting W/C. R. S. Mortley, A.F.C.; Acting W/C. E. Stephenson; S/L. C. W. Clark; S/L. G. D. Cremer, A.F.C.; S/L. J. W. Everitt; S/L. W. N. Gilmer, A.F.C.; S/L. E. W. F. Hare; S/L. K. N. Haselwood; S/L. J. E. Jacobs; F/L. J. S. Bennett; F/L. F. Bridgland; F/L. J. G. Burns (Retd.); F/L. R. M. Crawford; F/L. H. Currie; F/L. E. E. Fell; F/L. H. W. Gumbrell; F/L. C. L. Houghton; F/L. J. R. Johnson; F/L. R. Maclachlan; F/L. E. V. Mellor; F/L. B. H. Newton; F/L. J. L. Price; F/L. C. B. Sercombe; F/L. P. B. Smith; F/L. L. C. Spargo, A.F.C.; F/L. B. A. W. Stobart; F/L. J. F. Webster, D.F.C.; F/L. C. R. White; F/O. T. M. Hamer, A.F.M.; F/O. D. J. Lowery; F/O. R. J. Pritchard; F/O. R. Stephenson; M.Plt. G. T. Manson; Lt-Cdr. N. N. Ducker, R.N.(Retd.); Lt-Cdr. H. G. Julian, D.S.C., R.N.

With four Firestreaks up, a D.H. Sea Vixen FAW.1 flown by Lt.-Cdr. P. Barlow takes off on test from the de Havilland airfield at Hurn.

New and old at R.A.F. Yatesbury: a prototype Bristol/Ferranti Bloodhound mounted opposite the prototype Meteor (pictured on this page on March 14) at the station entrance.

No. 152 Sqn. Disbands

A DISBANDMENT parade of No. 152 (Hyderabad) Sqn., attended by the A.O.C. No. 11 Group (A.V-M. V. S. Bowling), is to be held at R.A.F. Stradishall on Friday, July 11, at 1100 hr, followed by lunch in the officers' and sergeants' messes and the N.A.A.F.I. Ex-members of all ranks are cordially invited to attend and those wishing to do so should write without delay to the Adjutant, No 152 Squadron, R.A.F. Stradishall, Newmarket, Suffolk.

C.F.S. Reunion

THIS year's reunion dinner of the Central Flying School Association is being held in the officers' mess, R.A.F. Little Rissington, Cheltenham, Glos, on Friday, July 11. Full particulars are being circulated to all members by the honorary secretary, F/L. R. G. Lofting.

Overseas Beverleys

BASED overseas since 1920 and operating Valettas for the past five years, No. 84 Sqn. is now re-equipping with Beverleys at R.A.F. Abingdon and thus will become the first squadron in an overseas command to fly this type of aircraft. Formed in 1917, No. 84 has operated during its forty-one years as a fighter, bomber, dive-bomber and transport squadron. Its present C.O. is S/L. H. W. Guile.

IN BRIEF

A. Cdre. M. Costello, A.O.C. the R.C.A.F. Maritime Air Command, is to retire from the Service next month and will be succeeded as from July 11 by A. Cdre. W. I. Clements, Chief of Personnel at R.C.A.F. headquarters.

* * * * *

The R.A.F. retained the Services' golf championship by beating the Royal Navy by 9½ pt to 2½ pt at Sandwich on June 17.

* * * * *

Runway arrester barriers are being installed at seven R.C.A.F. fighter bases in Canada this year—St. Hubert, Bagotville, Chatham, Comox, Cold Lake, North Bay and Uplands. The barriers, consisting of a network of nylon straps supported above a steel cable attached at either end to a piston inside a tube filled with anti-freeze, are positioned about 1,000ft short of the overshoot end of the runway. They are designed to stop tricycle-undercarriage aircraft up to the weight of the CF-100.

"Flight" photograph

Like Cinderellas waiting to go to the ball, Javelins of Nos. 23, 41 and 89 Sqns. lined up in readiness at R.A.F. Stradishall for their final rehearsal for the Queen's Birthday flypast which 16 of them were to make—but which eventually had to be abandoned owing to unfavourable weather.

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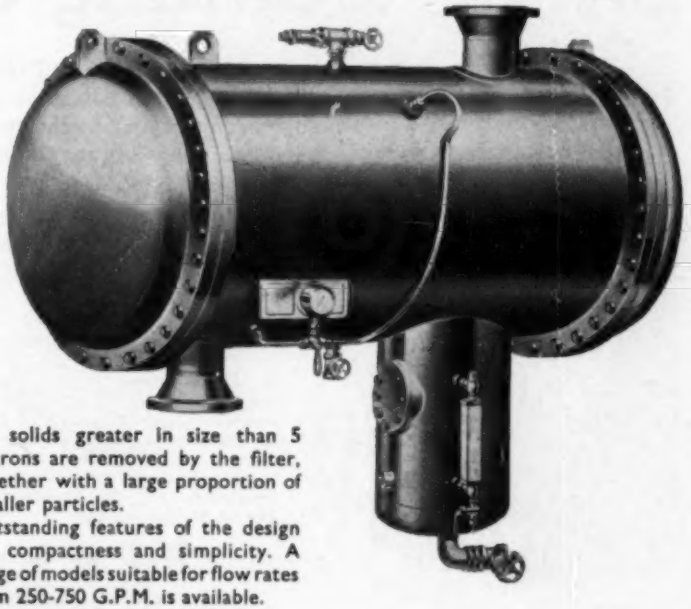

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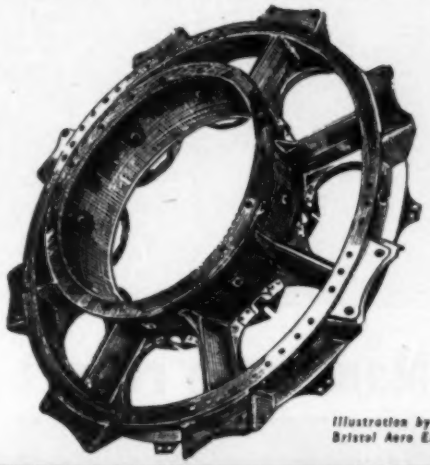

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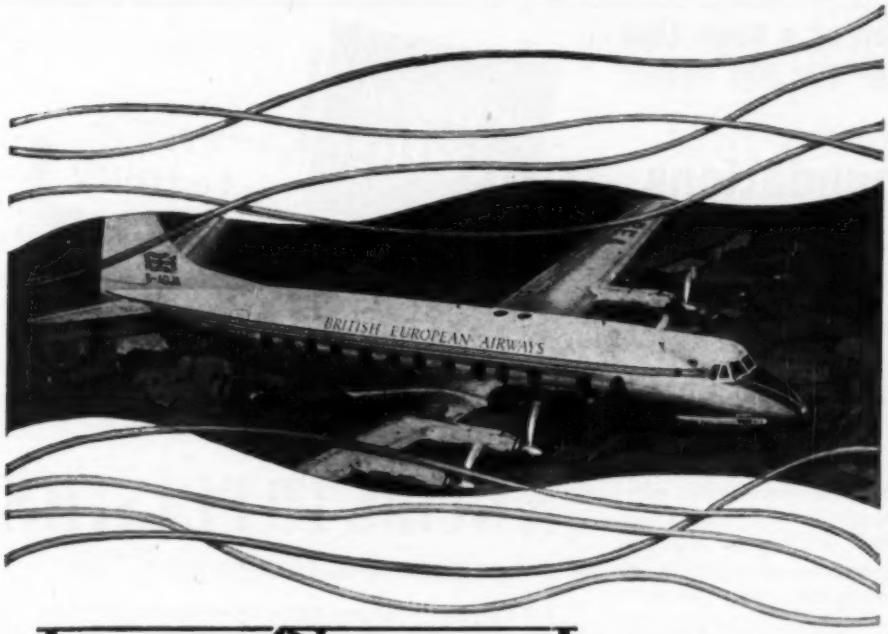

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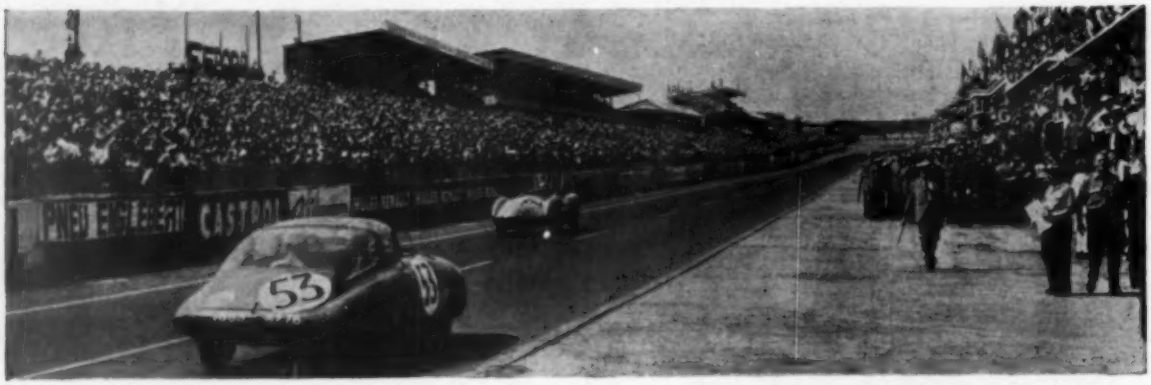

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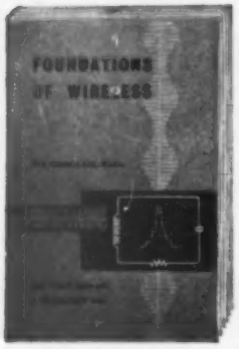

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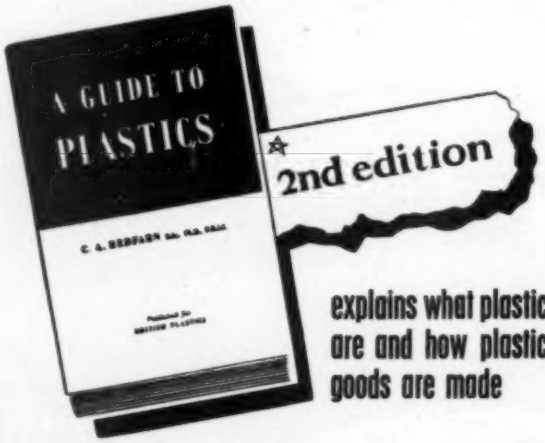

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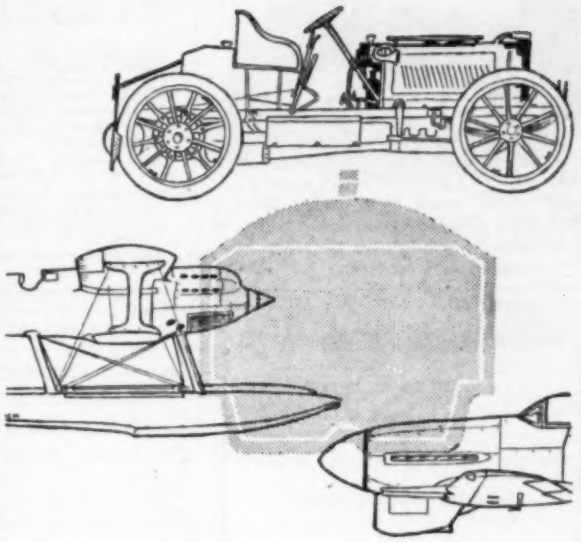

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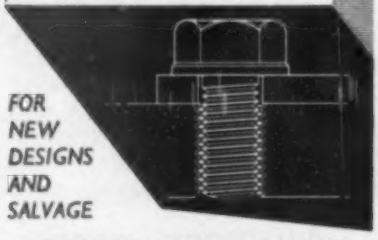

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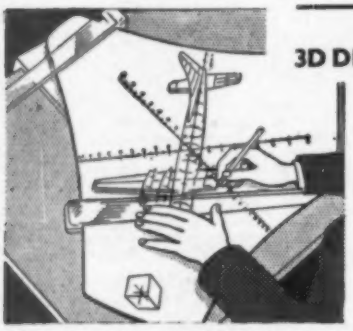

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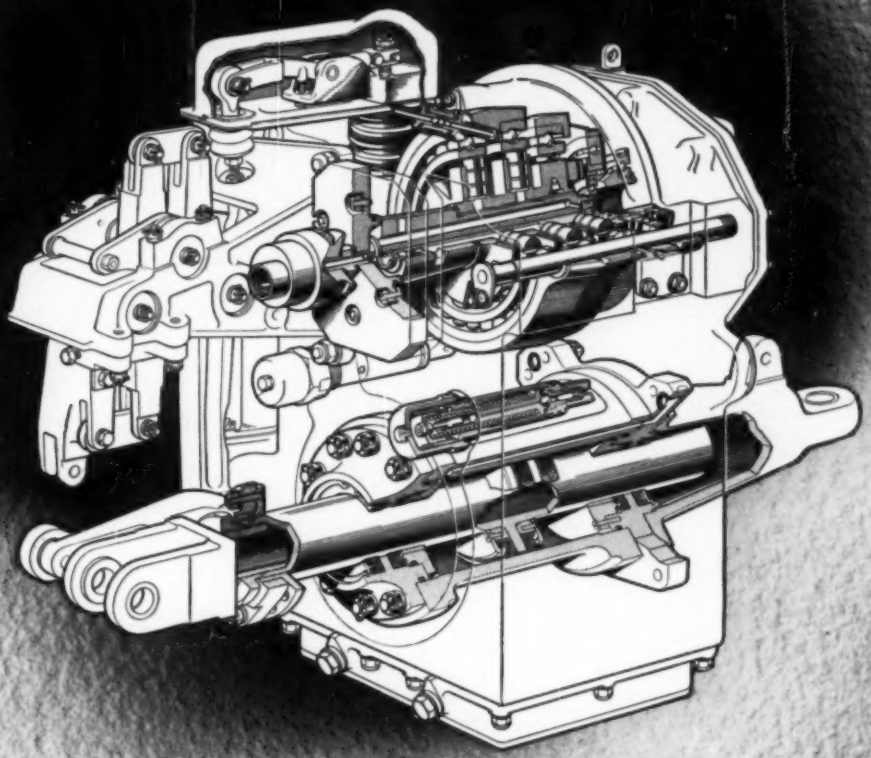

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